Habitat Associations of Small Mammals in Southwestern Indiana

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Introduction

There is relatively little information about the small mammals of southern Indiana. With changes in nomenclature based on Jones *et al.* (6), Mumford (10) listed the following with statewide distribution: *Cryptotis parva* (least shrew), *Blarina carolinensis* (southern short-tailed shrew), *Microtus pinetorum* (woodland vole), *M. ochrogaster* (prairie vole), *Synaptomys cooperi* (southern bog lemming), *Peromyscus leucopus* (white-footed mouse), and *Mus musculus* (house mouse). *Sorex cinereus* (masked shrew), common in the northern half of the state, also is known from the Wabash River watershed, including Posey County, and Mumford believed *Sorex longirostris* (southeastern shrew) and *Zapus hudsonius* (meadow jumping mouse) to be present in low numbers throughout southern Indiana.

This study was designed to determine the habitat associations, distribution, and relative abundance of the species of small mammals in the six counties bordering the Ohio River in southwestern Indiana, but especially shrews in the genus *Sorex*. Mumford (10) reported that only 28 southeastern shrews had been taken in Indiana prior to 1966, none from any Indiana county bordering the Ohio River. However, WAPORA, Inc. investigators, in studies conducted in Spencer County (unpublished), had captured 36 southeastern shrews, all but one by pitfall trapping. These results suggested that the supposed rarity of this shrew may have reflected poor sampling methods rather than low population densities. Consequently, a second objective of this study was to determine the relative efficiencies of snap vs. pitfall traps for sampling southeastern shrews. This objective was particularly important since the southeastern shrew is believed to be rare throughout much of its range, and is considered to be imperilled in several states.

Materials and Methods

Alternating oldfield and forest study plots were established at 6 km intervals along 280 km of the Ohio River. Using USGS topographic maps for reference and beginning at the southwestern boundary of Indiana (Posey County), marks were made on the maps at intervals of 6 km along the center line of the river. Plots were generally placed in the floodplain but where the escarpment was indefinite, absent, or at the river, the study area included lands to a line 4 km north of the center of the river. The entire study area (Figure 1) lies within the unglaciated part of Indiana, designated by Fenneman (2) as the Shawnee Section of the Interior Low Plateau Province.

This method allocated to each county between 3 (Warrick County) and 13 sites (Perry County). In Spencer County seven sites were located

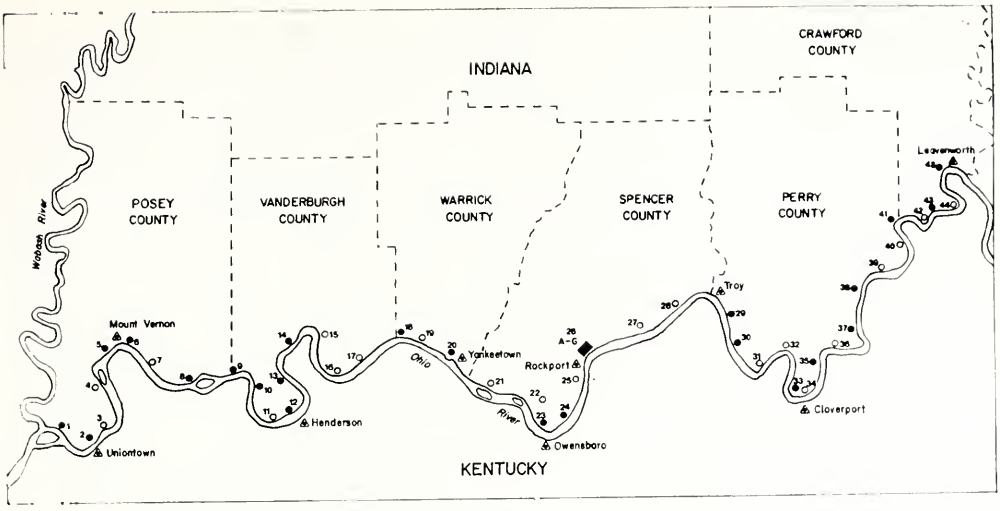

FIGURE 1. *The study area, showing the location of 25 oldfield (open circles) and 26 forested (closed circles) study plots. Location 26, the location of previous studies in Spencer County, included 4 oldfield and 3 forested study plots.*

along the river and seven other sites (26 A-G on Figure 1) were added in the vicinity of previous small mammal studies. Forests, defined as areas with trees 10 cm or more dbh, were selected for study in which shrubs covered 15 percent or more of the ground. Oldfield sites with perennial herbaceous plants, particularly goldenrods (*Solidago* sp.), asters (*Aster* sp.), and broomsedge (*Andropogon virginicus*) were selected whenever possible, but shrubs or saplings never constituted more than 15 percent of such oldfields. In both forests and oldfields, areas were sought in which a ground cover was formed by Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), grape (*Vitis* sp.), and other woody vines. With one exception, the bordering vegetation of the study plots was similar to that of the study site for a distance of at least 10 m from the margin. When possible, oldfield and forest plots were alternated. In all, there were 26 forest and 25 oldfield study plots.

Each study plot consisted of a 5 X 7 grid with trapping stations at 5 m intervals. At each station, one pitfall and one Museum Special snap trap were installed. The pitfall traps were polyethylene jars, 160 mm tall and 78 mm inside diameter, sunk flush with the surface, and partially filled with water. No bait was used. The Museum Special traps were baited with a mixture of rolled oats and peanut butter. (One trap in use for one night equals one trap-night.) Each site was trapped for three days during each of two periods. At most sites, the second cycle of trapping was conducted no more than seven days after the first cycle had been completed. All traps were neutralized between cycles by covering the pitfall traps with a sprung snap trap. The seven sites in Spencer County at the location of previous study (Sites 26 A-G) were trapped for four, and in one instance five, cycles.

Trapping was conducted from August through November 1977. Specimens were verified under the direction of John O. Whitaker, Jr., Curator, and are part of the Indiana State University mammal collection.

Results

In all, 454 small mammals of 10 species were obtained in 24,570 trap-nights. White-footed mice and prairie voles, with 213 and 78 individuals respectively, constituted 47 and 17 percent of the total (Table 1). Southern short-tailed shrews and house mice each comprised about 9 percent with the other species having smaller percentages.

The western counties (Table 1), trapped during the early weeks of the study, had higher trap success, 2.38 per 100 trap-nights for Posey and 2.51 for Vanderburgh Counties. Spencer County, with the highest number of trap-nights, also had the highest number of species, ten. Nevertheless, trap success for the county was slightly below average for the study, 1.65 per 100 trap-nights.

Oldfield habitat was more productive than forest (Table 2), both in terms of kinds (10 vs 7) and in individuals (261 vs 189.7, an adjusted number). Nearly all southeastern shrews, prairie voles, house mice, and meadow jumping mice were trapped in oldfields, but masked shrews, southern short-tailed shrews, white-footed mice, and woodland voles were collected more frequently in forested areas.

A comparison of the effectiveness of snap and pitfall traps is given in Table 3. Pitfall traps captured more species (10 vs 8) and also captured more individuals in seven of the ten species. However, three of the common species (white-footed mice, prairie voles, and house mice) were captured more frequently in snap traps, resulting in a greater number of total captures obtained by snap than by pitfall traps. Furthermore, the capture rate was more than twice as great for snap traps than for pitfall traps, 2.47 vs 1.22 captures per 100 trap-nights.

Discussion

Along the Ohio River in southwestern Indiana, white-footed mice were numerically dominant in forests and oldfields, but prairie voles were nearly as numerous in oldfields.

Most of the species appeared to be distributed along most of the 280-km study area, but both masked and southeastern shrews may have disjunct populations. The masked shrew was found in Posey and Vanderburgh (plus one specimen in Spencer) Counties, and the southeastern shrew in Spencer and Perry Counties.

Short-tailed shrews and white-footed mice are occupants of woodlands in the eastern United States (1, 5, 9), but they have considerable flexibility in the habitats that provide adequate resources to support their populations. For example, white-footed mice are frequent colonizers of disturbed areas, including areas altered by fires, grazing, floods and other disturbances (7, 8).

Least shrews are known to be primarily associated with upland, oldfield habitats. Whitaker (13) reported that he has taken approximately 150 least shrews from field areas in Indiana, but none from woods.

Less is known of the habitat relationships of Indiana shrews in the genus *Sorex*. In previous studies in Spencer County (WAPORA, unpub-

TABLE 1. *Number of individuals and species of small mammals captured within each county along the Ohio River in southwestern Indiana. Months, habitat types, and type of trap have been combined.*

SPECIES	Posey	Vanderburgh	Warrick	Spencer	Perry	Crawford	Totals	Percent
Masked shrew	5	7	0	1	0	0	13	3
Southeastern shrew	0	0	0	16	2	0	18	4
Least shrew	0	1	0	4	0	0	5	1
Short-tailed shrew	9	5	0	15	8	6	43	9
White-footed mouse	51	50	1	52	37	22	213	47
Prairie vole	11	11	0	28	26	2	78	17
Woodland vole	2	0	0	6	12	1	21	5
Southern bog lemming	0	0	0	1	0	1	2	<1
House mouse	0	18	0	16	9	0	43	9
Meadow jumping mouse	2	3	0	10	2	1	18	4
Total individuals	80	95	1	149	96	33	454	100
Total species	6	7	1	10	7	6	10	
No. of trap-nights	3360	3780	1260	9030	5460	1680	24570	
Trap success in percent	2.38	2.51	0.08	1.65	1.76	1.96	1.85	

TABLE 2. *Number and percent of small mammals taken in oldfield and forest habitats. In parentheses are the number of trap-nights in each habitat. Adjusted number of captures in the forest habitat obtained by multiplying by a factor (net oldfield traps/net forest traps).*

	Oldfield habitat (12180)		Forested habitat (12390)		
SPECIES	Total Number	Percent of captures within a species	Total Number	Total Adjusted Number	Percent of captures within a species (adj)
Masked shrew	2	16	11	10.8	84
Southeastern shrew	14	78	4	3.9	22
Least shrew	5	100	0	0	0
Short-tailed shrew	14	33	29	28.5	67
White-footed mouse	84	40	129	126.8	60
Prairie vole	72	92	6	5.9	8
Woodland vole	9	43	12	11.8	57
Southern bog lemming	2	100	0	0	0
House mouse	43	100	0	0	0
Meadow jumping mouse	16	89	2	2.0	11
Total individuals	261	58	193	189.7	42
Total species	10		7		

TABLE 3. *Comparison of two methods (pitfall and snap) for trapping small mammals, presented as total number and percentage of captures within a species, for combined oldfield and forested study plots. Numbers in parentheses indicate the number of trap-nights for each kind of trapping.*

	METHOD OF TRAPPING USED			
	Pitfall trapping (12285)		Snap trapping (12285)	
SPECIES	Total number	Percent of captures within a species	Total number	Percent of captures within a species
Masked shrew	12	92	1	8
Southeastern shrew	18	100	0	0
Least shrew	3	60	2	40
Short-tailed shrew	32	74	11	26
White-footed mouse	28	13	185	87
Prairie vole	25	32	53	68
Woodland vole	16	76	5	24
Southern bog lemming	2	100	0	0
House mouse	1	2	42	98
Meadow jumping mouse	13	72	5	28
Total individuals	150	33	304	67
Total species	10		8	
Trap success in percent	1.22		2.47	

lished), 27 of 36 (75%) of southeastern shrews were captured in oldfield habitats, nearly identical to the proportion (14 of 18, or 78%) observed in the present study. Southeastern shrews are found in oldfields for the most part, but some were captured in forested study areas. Perhaps its optimal habitat is similar to that of *Microtus pinetorum*, the woodland vole, which seems to be primarily at the forest edge rather than either within forests or oldfields (3). In the present study, slightly more than half of the woodland voles were taken from forests, but many forest plots contained Japanese honeysuckle or other understory vegetation, and some of the oldfields contained trees and shrubs (especially at the margin of the study plots). Consequently, many of the study areas contained sections that might best be classified as forest edge (ecotone), both in terms of light penetration and vegetation height. Of 26 southeastern shrews taken by Tuttle (12) in Tennessee, 24 were from habitats overgrown by honeysuckle. In the present study as well, slightly more than half of southeastern shrews were found in association with dense honeysuckle.

Eleven of 13 masked shrews, *S. cinereus*, were captured in forested plots. For southeastern and masked shrews, some evidence of mutual exclusion was observed, i.e., the presence of one species signalled the absence of the other species, except at the forested study plot in Spencer County at Site 23 (Fig. 1), where one specimen of each species was obtained. This represents the single exception for all of the WAPORA, Inc. studies of small mammals in southern Indiana. Although the ecology of the two *Sorex* species has not been reported in Indiana, two sympatric species of *Sorex (S. vagrans* and *S. obscurus)* have been studied by Hawes (4) in British Columbia, Canada. Studying known individuals that had been captured, marked and released, Hawes concluded that the physical separation of the two species was due to each species having a competitive advantage in its optimal habitat. It is likely that a similar situation exists between *S. cinereus* and *S. longirostris* from southern Indiana, tending to restrict the masked shrew to forested habitats and the southeastern shrew to oldfields. Indirect evidence in support of this hypothesis is given by Tuttle and Whitaker (pers. comm.) who state that in Wisconsin and northern Indiana, respectively, where *S. longirostris* is absent, *S. cinereus* occurs in a range of habitats, including oldfields.

Earlier studies had indicated that southeastern shrews were sampled effectively only by pitfall traps. This study supports that finding; all 18 southeastern shrews were taken in pitfall traps. The masked shrew, nearly identical in size and shape, was also more effectively trapped by pitfalls; 12 of 13 individuals were taken by that method. Placement of one pitfall and one snap trap at each trapping location permits a statistical analysis of trap effectiveness. Applying Fisher's Exact Probability Test (11, pp. 94-104), the probability of catching all 18 southeastern shrews in one type of trap based on chance alone is less than 0.0005. Similarly, the probability for masked shrews is 0.034. Thus, there is a significant difference in the frequency of capture that is attributable to the method of trapping. Tuttle (12) caught 23 of the 26 southeastern shrews in pitfall traps. Consequently, it does seem likely

that the inability of snap traps to catch the southeastern shrew has contributed in a real way to its supposed rarity in Indiana and elsewhere.

Acknowledgments

This study was conducted as part of an environmental study under a contract with American Electric Power Service Corporation for Indiana & Michigan Electric Company. Thanks are due the many landowners who consented to the use of their land. We are grateful to R. Hall, W. Lee, W. McClain, C. Rhodehamel, and J. McCormick, all of whom participated in the study in some capacity. Thanks are also due John Whitaker and Tom French of Indiana State University, both for verifying the identifications of *Sorex* and for reviewing an earlier version of this paper. Melissa Wieland made the figure.

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