Small Mammals of Southern Indiana

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Introduction

From October 1973 through November 1977, small mammals were studied in southern Indiana, intensively on a 1500 ha site near Rockport in Spencer County but also in five other southernmost counties as well. Initially, the objective was to determine the species present on the site (and their relative numbers) because there was not sufficient information on their status to serve as a basis for writing an environmental statement prior to the construction of a facility on the Rockport site. Furthermore, the site needed to be examined for the possible occurrence of any rare, threatened, or endanged species of mammal.

During the first two years, 26 *Sorex longirostris* (southeastern shrew) were taken by pitfall trapping. Because this shrew was considered to be threatened by some nearby states and was being evaluated for endangerment in Indiana, a third study sought to answer the question of whether the rarity of this shrew elsewhere may have been due to the methods of study rather than to actual low numbers. Finally, a fourth study examined whether the 1500 ha site was a focus for a locally dense population of *S. longirostris* by trapping in five neighboring counties in southern Indiana. The results of the last study have been reported in greater detail, especially with regard to habitat association and methods of study in (12). In addition, an independent estimate of the kinds and relative abundance of small mammals in the vicinity of the Rockport site was made possible by the discovery of a barn owl (*Tyto alba*) nest and roost site located nearby. Together, these studies provided the necessary information for the site as well as much valuable information on the mammals of southern Indiana. These studies identified local abundances of southeastern shrews and southern bog lemmings, new distribution records for at least 4 species, detailed information on the relative efficiencies of snap and pitfall traps, and much specific information on small mammals of forest and oldfield study plots.

Most of the intensive studies of mammals were conducted on the 1500 ha site, located in Spencer County in the unglaciated part of southern Indiana, or in the Shawnee Section of the Interior Low Plateau (physiographic) Province (3). The site is typical of Spencer County, with about 80 percent of the area under cultivation. Bisected by a small creek and lying near the Ohio River, the site also contained patches of floodplain and terrace forest, riparian strips and fencerows, but relatively few oldfields.

Description of the Study Areas

On the Rockport site, 8 oldfield and 7 forest plots were studied (Figure 1). During 1973 and 1974, quantitative and qualitative information was collected on the vegetation of 6 study plots (Plots H, I, J, K, L, O) then in use. (A detailed account of the vegetation of Spencer County is in preparation by W. McClain.) The 9 remain-

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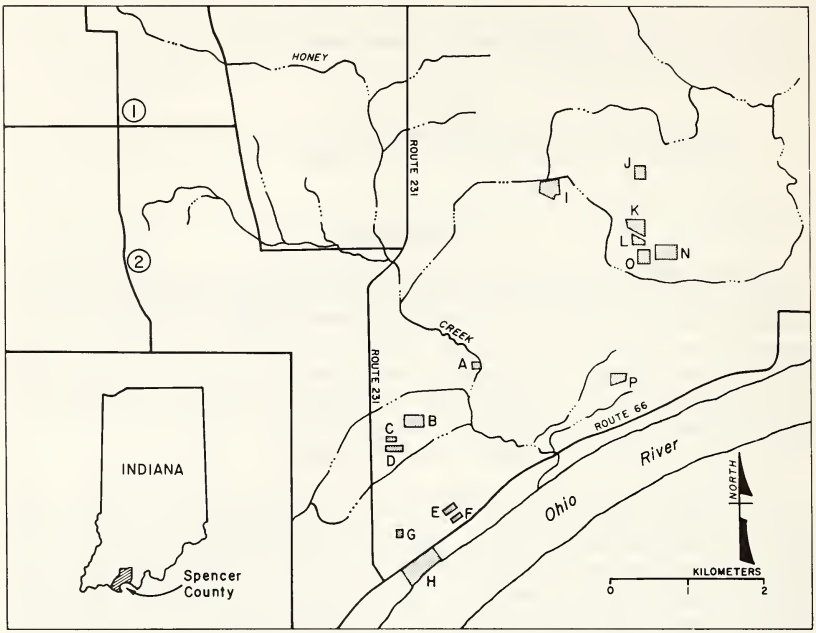

FIGURE 1. *The location of the 15 study plots (Letters A through N) on which the small mammals were studied on the Rockport site, Spencer County, Indiana. Location 1 was the site of the nest and roost for a barn owl, and the number 2 designates the location of a colony of eastern woodrats.*

ing plots, added in 1976 and 1977, did not have extensive vegetational studies. Brief remarks on the vegetation of the study plots follow.

Plot A is a low-lying oldfield located near Honey Creek. Goldenrod, ironweed, asters, horse nettle, trumpet creeper, and ground cherry were interspersed in a dense cover of grasses and sedges.

Plot B is a forest that was studied only in the immature section, where 10 m trees formed a continuous canopy. Pin oak, sweetgum, and red maple were predominant and American elm, black cherry, and sassafras were common associates.

Plot C is an oldfield bordered on one side by a mature forest and on other sides by cultivated fields. Path rush, panic grass, and tall goldenrod were the most conspicuous herbs, and red maple, pin oak, and American elm samplings were scattered throughout.

Plot D is a mature forest of veteran trees ranging from 40 to 100 cm dbh (diameter at breast height), and averaging about 20 m in height. The canopy trees were pin oaks, southern red oaks, swamp white oaks, and sweetgums. The subcanopy was composed of small individuals of those species in association with shagbark hickory, American elm, red maple, black oak, white oak, hackberry, and sassafras.

Plot E is an oldfield with an herbaceous cover of meadow fescue and goldenrod, dotted with scattered trees, mostly 1 to 3 m tall. Sweetgum and red maple

saplings were the most abundant trees, but silver maple, persimmon, green ash, and American elm trees also contributed to the discontinuous canopy which covered about 15 percent of the ground.

Plot F is an oldfield with meadow fescue, goldenrod, and Johnson grass as the predominant herbaceous vegetation. Trees were represented by widely scattered saplings of red maple and sweetgum.

Plot G is a forest in which persimmon, blackgum, oak, maple, hickory, and sassafras averaging 25 cm dbh were all abundant. A dense mat of Japanese honeysuckle covered the forest floor.

Plot H is a forest dominated by silver maple and eastern cottonwood, located in the floodplain of the Ohio River. This frequently flooded plot lay adjacent to cropland and the River.

Plot I is a red maple, pin oak forest located on the first terrace of the River. Although sometimes inundated, this mature forest had a well-developed litter layer and a large number of herbaceous plants.

Plot J and K are oldfields dominated by broomsedge, Kentucky bluegrass, and spreading witchgrass. Both plots were subject to periodic flooding.

Plot L is a red maple, pin oak forest located on the first terrace of the River. Sometimes flooded, this forest also had black willow trees, plus numerous red maple seedlings and saplings.

Plot N is an oldfield with goldenrod, path rush, broomsedge, field sorrel, and mountain mint as the herbaceous vegetation. The scattered woody plants included blackberry, saplings of red maple, sweetgum, and green ash.

Plot O is an oldfield lying near a small pond and covered by herbaceous vegetation and prostrate Japanese honeysuckle. Saplings of red maple, pin oak, and sassafras were scattered throughout the plot.

Plot P is a swamp white oak, shagbark hickory forest located on the first terrace. The forest, with trees averaging 35 cm dbh, had a dense ground cover of Japanese honeysuckle.

From August to November 1977, alternating forest and oldfield study plots were established at 6 km intervals along 280 km of the Ohio River. In all, 26 forested and 25 oldfields plots were placed within 4 km of the River in the 6 counties in southwestern Indiana (locations given in 12:433). In this study, forests were defined as areas with trees 10 cm or more dbh and at least 15 percent covered with shrubs. Oldfield sites had perennial herbaceous plants, such as goldenrods, asters, and broomsedge, and never had more than 15 percent of the area in shrubs or saplings.

Materials and Methods

In 1973 and 1974, the small mammals were collected using Museum Special snap traps, placed at 10 m intervals in transects within each study plot. The traps, baited with peanut butter, were examined daily for four mornings each month. (The southeastern shrews caught during this period were obtained in pitfall traps used to collect ground-dwelling insects).

From April 1976 through February 1977, each study plot (B, D, E, F, N in Fig. 1) was divided into 2 20 m by 20 m subplots, each with 9 trapping stations set 10 m apart. One pitfall and 2 snap traps were placed at each station. The pitfall traps, 160 mm polyethylene jars with 78 mm mouths, were buried with the top flush with the soil surface, half-filled with water, but unbaited. Run for 4 nights each month,

these procedures yielded a gross effort of 3,384 trap-nights for pitfall traps and twice that number for snap traps.

In autumn 1977, small 5 by 7 grids using 5 m intervals were measured on the 51 plots. One pitfall and one snap trap were placed at each intercept. Each study plot was trapped for 3 days during each of 2 periods, except the 7 plots on the Rockport site, which were trapped for 4, and in one instance 5, cycles. In most instances, the cycles were 1 to 2 weeks apart.

Pellets of the barn owl were collected from a roost and nest site located near the Rockport site (Fig. 1). The analysis of the skulls contained in pellets collected in October 1974, January and April 1975, and May and June 1976 provided information on the dietary selection of the owls, and more importantly, an estimate of the availability of the small mammals that were their prey foods.

Results

Ten species of small mammals were trapped during the 1973 and 1974 period (Table 1). Short-tailed shrews, southeastern shrews, white-footed mice, and house mice were obtained from all 6 study plots. Least shrews and prairie voles were restricted mostly to oldfields, and white-footed mice mostly to forests. Eight species of small mammals were taken by concurrent snap- and pitfall trapping in April 1976 to February 1977 (Table 2).

In the autumn 1977 study, 454 small mammals, comprising 10 species, were obtained by the concurrent methods (12:Table 3) in the 6 counties. The white-footed mouse, with 213 individuals, and the prairie vole, with 78 individuals, constituted 47 and 17 percent of the total. Other species in decreasing order of numbers were short-tailed shrew, house mouse, woodland vole, southeastern shrew, meadow jumping mouse, masked shrew, least shrew, and southern bog lemming.

TABLE 1. *Kinds and relative abundance (in %) of small mammals obtained by snap trapping on 3 forest and 3 oldfield study plots in Spencer County, Indiana during 1973 and 1974. Nomenclature follows (7).*

	Forest Study Plots							OldField Study Plots						
	H		I		L			J		K		O		
Species	%	No.	%	No.	%	No.	TOTAL	%	No.	%	No.	%	No.	TOTAL
Sorex longirostris	0.2	1	1.4	1	2.5	2	4	2.7	6	1.6	6	9.5	11	23
Blarina brevicauda	2.6	15	7.2	5	17.7	14	34	21.9	48	0.8	3	12.9	15	66
Cryptotis parva	0.3	2	1.4	1			3	11.4	25	7.8	30	0.9	1	56
Peromyscus leucopus	53.9	310	84.1	58	70.9	56	424	3.7	8	1.8	7	12.1	14	29
Microtus ochrogaster	6.6	38			1.3	1	39	21.0	46	82.3	317	62.1	72	435
Microtus pinetorum					1.3	1	1			0.3	1			1
Symaptomys cooperi	0.5	3			1.3	1	4	0.5	1	0.5	2	0.9	1	4
Rattus norvegicvus	0.9	5					5							
Mus musculus	35.0	201	5.8	4	5.1	4	209	36.1	79	4.9	19	0.9	1	99
Zapus hudsonius								2.7	6			0.9	1	7
TOTAL		575		69		79	723		219		385		116	720

TABLE 2. *Numbers of small mammals captured in snap traps (ST) and pitfall traps (PT) on the oldfield and forest study plots on the Rockport, Indiana site from April 1976 to February 1977.*

	Oldfield Study Plots									Forest Study Plots				
	E		F		N		O			B		D		
Species	ST	PT	ST	PT	ST	PT	ST	PT	TOTAL	ST	PT	ST	PT	TOTAL
Sorex longirostris		3						2	5		2		2	4
Blarina brevicauda	10	1	4				9		24	3	6	5	2	16
Cryptotis parva	16	10	17	5	5	4	3	2	62				1	1
Peromyscus leucopus	14		7	1			42	10	74	52	5	51	8	116
Microtus ochrogaster	2	5	7	3	14	4	1	7	43		1	1	3	5
Synaptomys cooperi	3	2	11	9	5	3	3	2	38					
Mus musculus	5		42	2			1		50					
Zapus hudsonius		2	1						3	1		2		3
TOTAL	50	23	89	20	24	11	59	23	299	56	14	59	16	145

A comparison of trapping efficiency (12:Table 3) indicated that pitfall traps were effective at sampling 7 of the 10 species. However, 3 of the common species, white-tailed mouse, house mouse, and prairie vole, were captured more efficiently in snap traps. Table 3 shows the composite results of both concurrent trapping

TABLE 3. *The number and percentage of small mammals obtained by concurrent snap- and pitfall trapping methods, including the 1976-1977 studies of the Rockport site and the study of 280 km of Ohio River in autumn 1977. The decimal amounts result from the standardization of the number of functional snap and pitfall traps during the 1976-1977 study. The numbers in parentheses are the non-adjusted number of trap nights.*

	Snap Traps (20949)		Pitfall Traps (16617)			
Species	Total number	Percent of captures within a species	Total number (adj.)	Percent of captures within a species	Total No. (adj.)	Percent of captures among species
Sorex cinereus	1	8	12.0	92	13.0	1.3
Sorex longirostris	0	0	33.2	100	33.2	3.4
Blarina brevicanda	42	47	47.2	53	89.2	9.2
Cryptotis parva	43	52	40.2	48	83.2	8.6
Peromyscus leucopus	351	84	68.8	16	419.8	43.2
Microtus ochrogaster	78	55	64.1	45	142.1	14.6
Microtus pinetorum	5	24	16.0	76	21.0	2.2
Synaptomys cooperi	22	43	29.0	57	51.0	5.2
Mus musculus	90	95	4.4	5	94.4	9.7
Zapus hudsonius	9	35	16.4	65	25.4	2.6
TOTAL	641	66	331.3	34	972.3	100.0

TABLE 4. *Food composition of barn owls (Tyto alba), based on examination of the contents of 527 pellets collected from a roost near the Rockport site, Spencer County, in October 1974, January and April 1975, and May and June 1976, and of food brought to young in the nest in spring 1976.*

	Adult Owls		Food brought to young	
	Total No.	Percent	Total No.	Percent
Blarina brevicauda	96	8.8	15	3.3
Cryptotis parva	68	6.2	2	0.4
Sylvilagus floridanus	1	0.1	1	0.2
Peromyscus leucopus	17	1.6	3	0.7
Neotoma floridana	1	0.1		
Microtus ochrogaster	734	67.0	362	80.3
Microtus pinetorum	2	0.2		
Synaptomys cooperi	159	14.5	64	14.2
Mus musculus	12	1.1	1	0.2
Zapus hudsonius	4	0.4		
Birds, all species	1	0.1	3	0.7
TOTAL	1095		451	

studies, obtained by pooling all of the habitats and standardizing the results to compensate for the unequal number of nights of use of pitfall and snap traps. These results are similar to (12:Table 3), except that proportionately fewer prairie voles were caught in snap traps.

The remains of more than 1500 small mammals of 10 species were identified from the owl pellets and the skeletal remains of mammals brought to feed nestlings (Table 4). The pellets yielded one each of eastern cottontail, *Sylvilagus floridanus*, and eastern woodrat, *Neotoma floridana*, whose presences also were known from the existence of woodrat houses and by direct observation, but not from trapping.

Discussion

Based on the reults of these studies, 11 species of small mammals are known to occur in southern Indiana. These include those listed in Table 1, plus the masked shrew (Table 3).

Overall, the white-footed mouse was the most numerous small mammal in forested plots, and the prairie vole in oldfield plots. These results are consistent with other studies of the species and of the region. For example, Batzli (1) found white-footed mice to be the most numerous small mammal in the floodplain and upland forests near the Sangamon River in Illinois. Batzli reported that although the floodplain appeared to be a more severe and less predictable habitat for mice than the upland, *P. leucopus* was more productive there than in the upland. For several groups of organisms at the Rockport site, including some species of mammals and arthropods, the floodplain forest (Plot H) was also highly productive. Plot H was located adjacent to productive croplands of alfalfa and soybeans. White-footed mice eat insects and other arthropods in season, but rely on seeds, fungi, and other plant material when invertebrates are scarce.

In contrast to the white-footed mouse, the prairie vole eats mostly leaves and stems of herbaceous plants. Prairie voles require forbs in the diet, for Getz et al (6) have shown that in Illinois prairie voles cannot sustain populations when fed only grasses. Consequently, there are well suited to living in the oldfields at the Rockport site, where a mix of grasses and forbs is present. In similar habitats in the Midwest, other investigators (4, 5, 8) also have found prairie voles to be numerically dominant.

The house mouse, *Mus musculus*, usually is present either in oldfields of early successional stage or as a commensal of man, i.e., in barns, corn cribs, sheds, and houses. In oldfields, as the habitat changes from annual grasses and forbs to perennial grasses during the course of succession, microtine rodents become increasingly common, and may displace house mice. The interference by *Microtus* of field populations of house mice has been demonstrated experimentally by DeLong (2), and Lidicker (9) reported the population events of a feral house mouse population declining to extinction in competition with *Microtus*. This adverse effect of *Microtus* on house mouse populations is evident in the reciprocal densities of the 2 species on Plots H, J, K, and O (Table 1). When prairie vole densities are high, as in Plots K and O, house mouse numbers are low.

Eight specimens of the southern bog lemming, *Synaptomys cooperi*, were obtained equally from forest and oldfield plots during the early studies at Rockport (Table 1), and *Synaptomys* ranked seventh of 10 species caught with snap traps. However, the combined snap and pitfall methods yielded 51 specimens, slightly more than half of them taken by pitfalls (Table 3). All were from oldfields. Southern bog lemmings were frequently taken by barn owls (Table 4), and ranked behind only prairie voles in this regard. These 2 microtine rodents are the largest common mammals in the oldfields of the Rockport site, with adults usually in the 35 to 45 g range. Barn owls took 1 southern bog lemming for every 5 prairie voles (Table 4), but snap traps caught 100 times more of the latter than the former in oldfields (Table 1). These results probably mean both that prairie voles are more readily caught in snap traps than are southern bog lemmings, and that barn owls took southern bog lemmings at a greater frequency than expected by their true abundance, probably because of their relatively large size.

During the 1973 and 1974, forest and oldfield plots yielded 1 each of woodland vole (*Microtus pinetorum*) with snap traps, but in the 2 studies with concurrent snap and pitfall trapping, 21 woodland voles were obtained (Table 3). Of the 21, only 3 were from the Rockport site, indicating that they may be more common in some other areas along the Ohio River than there. All but 4 were taken from forested study plots and 16 of the 21 were obtained with pitfall traps. Woodland volves were seldom caught by barn owls (Table 4), another indication that woodland voles are predominantly forest dwellers.

Four species of shrews were taken in these studies, with the short-tailed shrew, *Blarina brevicauda*, the most common. *Blarina* ranked fourth of 10 species in the number of small mammals taken by snap traps (Table 1), it had the same rank in the concurrent studies (Table 3), and was third of 10 species taken by barn owls (Table 4). About 65 percent were obtained from oldfield plots (Tables 1 and 2).

At the Rockport site, all but 4 of more than 100 least shrews (*Cryptotis parva*) were from oldfields, and 2 of those were from the floodplain forest, Plot H, which was vegetationally diverse and lay adjacent to cropland. Whitaker (13) trapped more than 150 *C. parva* in Indiana, all in oldfields.

The 54 southeastern shrews caught in these studies represent one of the few

large samples of this species anywhere. In the concurrent trapping, all were taken in pitfall traps, and 78 percent were caught in oldfields (11). These results reinforce the belief that the supposed rarity of the southeastern shrew may be more a consequence of the sampling methods than the true abundance of the shrew. They also confirm Mumford's (10) belief that it has a spotty distribution; 48 were obtained on the Rockport site. Southeastern shrews, with 12 specimens obtained by concurrent trapping in autumn 1977, were second in abundance at the Rockport site then.

By contrast, no masked shrews (*Sorex cinereus*) were taken at the Rockport site. The majority of the *S. cinereus* were obtained from forested plots in Posey and Vanderburgh counties. Only at one location, in western Spencer County, were both species of *Sorex* taken from the same study plot. The masked shrew, a north temperate species, seems to be restricted to the Wabash and Ohio River Valleys in the southern half of Indiana (10:Fig. 5), except for a relict population of a different subspecies in Ripley County. These studies add Vanderburgh and Spencer counties to the known distribution in Indiana.

Overall, shrews were frequently taken as prey by the barn owls (Table 4), but neither *Sorex* was detected. Despite their small size, shrews constituted about 15 percent of the vertebrate prey of these barn owls.

Mumford (10) believed the meadow jumping mouse (*Zapus hudsonius*) to be rare in the southern two-thirds of Indiana, and he stated that specimens were lacking from the Ohio River Valley. All 7 *Zapus* obtained with snap traps in 1973 and 1974 were taken in oldfields, as were 19 of 24 taken later. Fifteen of the 24 were obtained in pitfall traps in the concurrent trapping studies. *Zapus* was caught in Posey, Vanderburgh, Spencer, Perry, and Crawford counties (12).

The best information for this study is of the Rockport site, where 4 studies found one species to be restricted mostly to forested habitats, the white-footed mouse (84%). This species is probably the most numerous forest mammal in eastern North America, and Mumford (10) considers it to be one of Indiana's most common mammals.

Five species were taken primarily in oldfields at the Rockport site, including least shrew (97%), prairie vole (92%), southern bog lemming (91%), southeastern shrew (78%), and meadow jumping mouse (77%). House mice (42%) and short-tailed shrews (64% in oldfields) showed no clear habitat preferences. All 5 Norway rats (*Ratus norvegicus*) were caught on Plot H.

The studies with concurrent trapping seemed to confirm that southeastern shrews are sampled more effectively by pitfall than by snap-trapping methods. All 27 southeastern shrews, and 12 of 13 masked shrews, were taken in pitfall traps (11). Masked shrews are nearly identical in size, shape, and external features to southeastern shrews. Other species for which pitfall traps proved to be more efficient were short-tailed shrews (74%), woodland voles (76%), and meadow jumping mice (72%). Snap traps were effective in trapping white-footed mice (87%), prairie voles (68%), and house mice (98%). The least shrew and southern bog lemming had so few captures that no evaluation could be made.

In conclusion, the small mammals of Spencer County and five other southernmost counties in Indiana are a diverse assemblage including 4 shrews and 3 microtine rodents. The distribution of some species seemed to be spotty in autumn 1977, when the majority of masked shrews were taken in Posey and Vanderburgh counties, of southeastern shrews in Spencer County, and of woodland voles in Spencer and Perry counties. The results of this study supply new information about local abundance of southeastern shrews and southern bog lemmings, and

new distribution records for meadow jumping mice, eastern woodrats, masked shrews, and southeastern shrews.

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Literature Cited

1. BATZLI, G.O. 1977. Population dynamics of the white-footed mouse in floodplain and upland forests. Amer. Midland Nat., 97:18-32.
2. DELONG, K.T. 1966. Population ecology of feral house mice: interference by *Microtus*. Ecology, 47:481-484.
3. FENNEMAN, N.M. 1938. Physiography of eastern United States. McGraw-Hill Book Co., New York. 714 pp.
4. FITCH, H.S. 1957. Aspects of reproduction and development in the prairie vole (*Microtus ochrogaster*). Univ. Kansas Publ., Mus. Nat. Hist., 10:129-161.
5. GAINES, M.S., and R.K. ROSE. 1976. Population dynamics of *Microtus ochrogaster* in eastern Kansas. Ecology, 57:1145-1161.
6. GETZ, L.L., L. VERNER, F.R. COLE, J.E. HOFFMANN, and D.E. AVALOS. 1979. Comparisons of population demography of *Microtus ochrogaster* and *M. pennsylvanicus*. Acta Theriol. 24:319:349.
7. JONES, J.K., JR., D.C. CARTER, and H.H. GENOWAYS. 1979. Revised checklist of North American mammals north of Mexico, 1979. Occ. Paps. Mus. Texas Tech. Univer. #62. 17 pp.
8. KREBS, C.J., B.L. KELLER, and R.H. TAMARIN. 1969. *Microtus* population biology: demographic changes in fluctuating populations of *M. ochrogaster* and *M. pennsylvanicus* in southern Indiana. Ecology, 50:587-607.
9. LIDICKER, W.Z., JR. 1966. Ecological observations on a feral house mouse population declining to extinction. Ecol. Monogr., 36:27-50.
10. MUMFORD, R.E. 1969. Distribution of the mammals of Indiana. Indiana Acad. Sci., Monogr. No. 1, 114 pp.
11. ROSE, R.K. 1980. The southeastern shrew, *Sorex longirostris*, in southern Indiana. J. Mamm., 61:162-164.
12. ROSE, R.K., and R. MCKEAN. 1980. Habitat associations of small mammals in southeastern Indiana. Indiana Acad. Sci., Proc. 89:432-439.
13. WHITAKER, J.O., JR. 1972. *Zapus hudsonius*. Mammalian Species, No. 11:1-7.