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BRIEF NOTE

DISTRIBUTION OF SHORT-TAILED SHREWS IN A WOODED VALLEY IN SOUTHEASTERN OHIO[1]

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A number of environmental factors affecting the distribution of small mammals have been identified and widely studied. These include, but are not limited to, soil temperature (Pruitt 1953, 1959), texture (Whitaker 1968), color (Hardy 1945), nutrient content (Krebs *et al* 1971), density, type and structure of vegetation (M'Closkey 1975, 1976; Myton 1974, Mossman 1955), and evaporation rate (Orr 1959; Neal and Lustick 1973). The present study was an attempt to interpret the local distribution of the short-tailed shrew, *Blarina brevicauda* at Neotoma, a 41 ha wooded valley in southeastern Ohio. The site was particularly suitable because of the abundance of ecological data already collected there. The objective of the study was to determine whether population density of the short-tailed shrew differed significantly on northeast as compared to southwest facing slopes. If differences did occur, a second objective was to determine the factors responsible.

The population was sampled using Sherman live traps (7.5 x 7.5 x 25 cm). A quadrat measuring 310 x 40 m was marked across the valley. It began at the cliff face at the top of the southwest facing slope and ended at the top of the northeast facing slope. The vegetation and soils of this quadrat are described by Gilbert and Wolfe (1959), Riemenschneider (1964) and Phipps (1964). Within the quadrat were 146 trap stations spaced 10 m apart in a 5 column 32 row pattern. Each station was marked with a permanent stake. Traps were baited with peanut butter and sunflower seeds and set within one meter of their stakes where they remained for the duration of the study. There were 71 traps on the southwest facing slope and 75 on the northeast facing portion. Trapping began on 23 July 1974 and concluded on 23 November 1974. There were 16 trapping periods ranging in duration from 2 to 7 days. A total of 60 days or 8760 trap days were involved. All traps were checked daily during each trapping period. At the end of each trapping period, traps were sprung and left in place. They were re-set at the beginning of the next trapping period. The longest lapse between trapping periods was 7 days. Animals captured were sexed, aged, marked by toe-clipping and released at the point of capture.

Trap mortality was high. Of 29 shrews captured, 26 died in the traps. Two of the remaining three were recaptured twice. Twenty-three of the 29 were taken in traps on the northeast facing slope and only 6 on the southwest facing area. Assuming a non-selective random distribution of captures, a Chi-Square value of 9.96 ($P<0.01$) indicated that the shrews were not randomly distributed but demonstrated a strong preference for the northeast facing slope.

There are a number of possible explanations for this distribution pattern. These animals obviously will be excluded from areas where tolerance limits for any environmental factor are exceeded. The short-tailed shrew is fossorial, living in the upper layers of the soil or beneath the litter at the soil surface. It propels itself through the soil or litter by a series of jerky thrusts (Hamilton 1930, 1931; Pruitt 1953). The soil matrix inhabited

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by this mammal must be of a consistency that permits easy penetration (Hardy 1945; Pruitt 1959). The major soil type on the northeast facing slope was the Neotoma series (Riemenschneider 1964). This soil has well developed and continuous O and A horizons with a combined depth of 30 cm. The high organic content of the A horizon appeared to facilitate tunneling by shrews. Soils of the southwest facing slope were of the DeKalb series. They had a poorly developed A horizon and a discontinuous O horizon covering approximately 20 percent of the area and averaging 8 cm or less in depth. This slope exhibited more surface erosion with nearly half the area devoid of leaf litter throughout most of the year (Cannon 1964). Leaf litter present was collected under shrubby vegetation.

Chew (1951) found that short-tailed shrews lost more water by evaporation than either *Peromyscus* or *Microtus*. Pruitt (1959) and Getz (1961) theorized that the air in the shrew's runway must be saturated with water vapor if the animal is to maintain a water balance. Getz (1961) believed that even short periods with humidity below saturation would be sufficient to preclude occupation of an area by *Blarina*. Riemenschneider (1964) states that a continuous O horizon would result in a thicker A horizon and that both are important in preventing run-off, increasing soil moisture and reducing evaporation. Laughlin (1964) found that, during droughty periods, the DeKalb soils in this valley were dry, whereas the Neotoma soils remained moist.

The thermal neutral zone of the short-tailed shrew ranges from 25 °C to 33 °C, and the upper lethal temperature is 35 °C (Neal and Lustick 1973). Platt (1974) hypothesized that this mammal could not tolerate an ambient temperature above 30 °C.

Temperature data collected at Neotoma (Riemenschneider 1964) demonstrated that on the southwest facing slope from late spring to early autumn, the average minimum temperature was 25 °C and the average maximum 31 °C on the leaf litter (OLL). The extreme high temperature was 51 °C. Average temperatures under the leaf litter (ULL) were 17 °C minimum and 24 °C maximum. On the northeast facing slope, comparable temperatures were OLL 16 °C minimum and 25 °C maximum with an extreme high temperature of 29 °C. ULL the range was from 13 °C minimum to 20 °C maximum with an extreme of 23 °C. At depths of 15 cm and 46 cm, there was no difference in temperature on the two slopes.

The abundance and availability of food may have influenced the distribution of the shrews. Platt (1974) and Neal and Lustick (1973) demonstrated that the observed metabolic rate of *Blarina* was approximately twice the predicted value. This exceptionally high metabolic rate would limit the shrew's distribution to areas where food was relatively abundant and easily obtained. The diet of the shrew consists mainly of invertebrates (Shull 1907, Hamilton 1930).

Cannon (1964) believed that there would be a greater diversity of invertebrates on the northeast facing slope. In order to determine whether the population density and biomass of soil invertebrates would be different on the two slopes, thirty 200 cm² samples of soil and litter were collected from the trapping sites. A sample was collected from the vicinity of each stake in the center row in the quadrat. This provided 15 soil samples from each slope. The kinds and numbers of macro-invertebrates recovered from the samples are indicated in

TABLE 1
Invertebrates collected from soil samples.

Invertebrate Group	Number of individuals per Slope	
	N.E. Facing	S.W. Facing
Roundworms	1	0
Earthworms	21	18
Millipedes	5	0
Centipedes	21	16
Spiders	7	3
Insects		
Orthoptera	1	0
Hemiptera	2	0
Collembola	1	3
Coleoptera	11	6
Lepidoptera	2	1
Diptera	8	5
Hymenoptera	9	6
Snails	2	2

table 1. The number of individuals collected from the northeast facing slope was significantly greater ($\chi^2 = 6.36$, $P < 0.05$) than from the southwest facing slope. This higher population density and the more diverse group of soil invertebrates on the mesic slope would support a larger number of short-tailed shrews, if food was a limiting factor.

The low number of short-tailed shrews trapped on the southwest facing slope may be attributed to a combination of factors. There appeared to be less quantity and diversity of the principal food of the shrew in this area. The soils of this slope exhibited a discontinuous O and a poorly developed A horizon. These factors, in turn, affected the moisture content and friability of the soil, which are important to the survival of this fossorial animal. The extreme and average temperatures recorded OLL and ULL would appear to offer possible explanations for the distribution pattern found. The mesic northeast slope exhibited a more favorable and homogeneous environment, which resulted in a considerably higher average density. Short-tailed shrews were obviously not excluded from the southwest slope, but the potentially habitable areas were more restricted there. Shrews are probably limited to the spots where leaf litter collected under the shrubby vegetation.

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