

Relationship of *Mus*, *Peromyscus* and *Microtus* to the Major Textural Classes of Soils of Vigo County, Indiana

JOHN O. WHITAKER, JR., Indiana State University

Abstract

Soils of Vigo County, Indiana, are of three major textural classes: upland silt loam, bottomland silt loam and sandy loam. The common small mammals of the county were studied in relation to the distribution of these soils in cultivated, oldfield and wooded situations. Both *Mus musculus* and *Peromyscus maniculatus bairdi* occurred in greater abundance in sandy loam than in the silt loams. It was hypothesized that this was because of better cover due to increased herbaceous vegetation in the case of *Mus* and because of looser soil for burrowing in the case of *P. m. bairdi*. In oldfields, *Microtus ochrogaster* was widely distributed in fair and good cover in all three soil types, but *Microtus pennsylvanicus* was essentially limited to bottomland silt loam in areas with good herbaceous cover. In wooded situations, *Peromyscus leucopus* was more abundant in bottomland silt loam than in upland silt loam, possibly because of increased herbaceous cover there.

Introduction

During studies of the mammals of Vigo County, Indiana (5), it was pointed out that the distribution of some species might be correlated with differences in the soils. This paper is an attempt to determine if such correlations existed.

Methods

Mammals included in this study were collected by means of snap-traps in a series of 429 randomly chosen study plots in Vigo County. Twenty-five traps baited with peanut butter were used in each plot for three nights. The trapping methods are discussed in detail in a general paper on the mammals of the county (5). Details concerning the vegetation in the various habitats is presented in a paper on the food habits of some of the species (4).

Information concerning the soil types is from the soils map of the county presented by Shannon (3), but the soil nomenclature has been updated by using the Resource Area Map of Vigo County, published by the United States Department of Agriculture.

Information concerning the mammals was converted to number taken per 100 trap-nights and summarized by soil type in the following three general habitat categories: cultivated areas, woodland areas, and old-field areas. Comparisons were made and conclusions were drawn regarding soil influence on relative population size. Chi-square goodness of fit tests were used to test the null hypothesis that there was no difference in the density of mammals with respect to the various soil types.

Description of Vigo County

Vigo County, which includes 402 square miles, is located in west central Indiana and borders Illinois. The Wabash River enters the north central portion of the county and flows to the southwest, forming

the Illinois-Indiana border in the southwest part of the county. The major creeks of the county flow into the Wabash River, three from the west and four from the east, while a few small streams in the southeast part of the county flow into the Eel River. The main valley of the Wabash River is about five to six miles wide, thus greatly influencing the topography of the county. This valley was the bed of the much wider glacial Wabash River, and in it are present many flood ponds, bayous and permanent ponds. A terrace about two miles wide runs the length of the county along the eastern edge of the valley. This terrace is about 40 to 80 feet above the valley throughout most of the county but grades into the bottomlands in the south. The uplands, in turn, are about 40 to 80 feet above the level of the terrace. Bluffs, forming the boundary between the upland and the terrace, are often quite abrupt.

Underlying the county are great beds of coal. There are numerous shaft mines, and 7,727 acres (1) have been stripmined for coal.

The entire area of the county was covered by the Illinoian Glacial advance, while the Wisconsin terminal moraine is present in the northwest corner of the county.

Soils of Vigo County

There is no recent soil survey of Vigo County, although one is currently in progress.

Shannon (3) listed 10 types of soils as occurring in Vigo County. They were Knox silt loam, Modi silt loam, Wabash silt loam, Sioux sandy loam, Wabash clay loam, Wabash gravelly loam, Sandy clay loam, Vigo black prairie, Knox sand, and morainic soils.

The three major soil types of the county are the Knox silt loam occurring on the uplands, the sandy loams on the terrace and the Wabash silt loam of the flood plains. The Morainic soils, the Knox sand, and the Vigo black prairie soils are distinctive, but not enough information was accumulated concerning the mammals occurring on them to draw meaningful conclusions. Discussion will thus be limited to the three major groups of soils of the county, termed here the upland silt loam, the bottomland silt loam and the sandy loams.

Upland silt loam

Included in this category are the Knox and Modi silt loams of Shannon, totaling about 212 square miles. This is the most extensive soil type in the county and occurs over most of the uplands on both sides of the main river valley. The soils here under the present classification scheme belong mostly to the Alford, Princeton, Cincinnati, Gibson, Muren, Iva, and Iona, and to the 852, 853 series, according to the Resource area map of Vigo County published by the United States Department of Agriculture. They are essentially light colored wind deposited forest silty clay loams of Illinoian till. Most of the land in this soil class is level or only gently undulating.

Bottom land silt loam

The bottom land silt loam category includes mainly the Wabash silt loam but also the Wabash gravelly loam of Shannon. It is the

water deposited soil of the bottoms of the Wabash River and the main streams of the county, comprising about 71 square miles. The soils here are light to grayish brown depending on the amount of organic matter present. They are essentially of Wisconsin or Illinoian outwash, depending on the soil types in the areas of their origin. The soil is tacky and forms clods if plowed when wet. These soils are usually well drained except in slough areas, where many bayous and flood ponds are present. Much of the included area is flooded nearly every year in late winter or in spring. Soils here are currently in the Genesee, Eel and Shoals series.

Sandy loam

The Sioux sandy loam of Shannon is the major soil of the terrace. Two minor soil types, the sandy clay loam and Wabash clay loam, are also included. These soils are currently included in the Fox, Ockley and Warsaw series. They consist of dark colored, wind deposited prairie sandy loams. The soil is brown to black, from 19 to 24 inches deep and contains a great amount of organic matter. Below the surface are layers of gravel, usually many feet in depth. The land is generally level and is excellent for farming.

Cultivated Situations

There were eight habitats in strictly cultivated situations. They were plowed fields (48 plots), Soybeans (16), Wheat (9), Corn (38), cultivated fields (Sorghum, *Lespedeza*, and Clover, 22), Soybean stubble (22), Wheat stubble (15), and Corn stubble (50).

Two species of mice, *Mus musculus* and *Peromyscus maniculatus bairdi*, were abundant enough in these situations to be considered. *Mus*, in cultivated situations in Vigo County, occurs in increased numbers with increased ground cover (5). This is well illustrated in Table 1 (note the numbers of house mice per 100 trap-nights of 2.97, 4.44 and 3.20 in fair to good cover, and the corresponding numbers of 0.55, 0.24 and 0.00 in poor cover, in the major soil types). Apparently *Mus* moves from area to area as good cover becomes available. *Peromyscus maniculatus bairdi* shows increased numbers with less ground cover (5). Since cover influences mouse abundance so strongly, information concerning soil was summarized separately by cover type.

In both *Mus* and *P. m. bairdi* it should be noted that both types of silt loam support similar numbers of mice, probably because the two soils have many similarities. Both are, of course, silt loams, and actually much of the bottomland soil would have originated in the surrounding uplands, hence would be basically similar to the upland silt loams. The question thus has been narrowed to the comparison between the silt loams and the sandy loams.

In fair to good cover, *Mus* was significantly more abundant in the sandy loam than in the silt loams (Chi-square = 11.17**, 1 df). It would seem likely that the increased numbers of *Mus* in the sandy loam would be because of increased herbaceous ground cover there. If this line of reasoning is correct, there should be a greater proportion of plots

TABLE 1

Mus musculus and *Peromyscus maniculatus bairdi* as associated with soil types in cultivated situations in Vigo County, Indiana.

	Fair-Good Cover			Poor Cover		
	Trap-nights	No. of Mice	No. Mice 100 trap-nights	Trap-nights	No. of Mice	No. Mice 100 trap-nights
UPLAND SILT LOAM						
<i>Mus</i>	3900	116	2.97	4200	23	0.55
<i>P. m. bairdi</i>		66	1.69		93	2.21
BOTTOMLAND SILT LOAM						
<i>Mus</i>	1500	48	3.20	1125	0	0.00
<i>P. m. bairdi</i>		11	0.73		20	1.78
SANDY LOAM						
<i>Mus</i>	3150	140	4.44	2100	5	0.24
<i>P. m. bairdi</i>		114	3.62		88	4.19

with better cover in the sandy loam than in the silt loams. Of 40 plots in corn, soybeans and cultivated fields in the silt loams, 33 or 82.5% had good or fair cover and 7 or 17.5% of the plots had poor cover. In 26 plots in sandy loam, 24 or 92.3% had fair or good cover, while only 2, or 7.7%, had poor cover. Although not significant (Chi-square = 0.17, 1 df) the low number of plots in poor cover would infer support for increased ground cover in the sandy loam. The small sample size here may explain the lack of significance.

Increased vegetative cover in the sandy loam could result from differences in nutrient or water holding ability, increased aeration because of larger soil particles in the sandy loam, or differences in fertility. Fertility would not seem to be a factor, however, since we are discussing here cultivated lands in which widespread and variable fertilizing is practiced.

If the above reasoning is correct, that is, that *Mus* is more abundant on the sandy loam because of increased amounts of herbaceous cover there, it would seem that *P. m. bairdi*, which attains larger populations in poorer cover, would attain larger populations on the silt loams than on the sandy loam, since the average amount of cover is less there. Actually, as with *Mus*, the sandy loam supports significantly greater numbers of *Peromyscus* (Chi-square = 61.57**, 1 df) than does the silt loam. Increased abundance of *P. m. bairdi* with decreased herbaceous ground cover does not mean that the species does not need cover. Rather, this mouse utilizes another type of cover. It burrows in the soil. For this reason, the ease of burrowing in a soil might be an important difference between soil types with respect to mice living there. The sandy loam might be easier to burrow in than the silt loams. If the

soil was simply harder to burrow in than the silt loam, then there is no reason why there should be decreased numbers of mice overall. If food and other limiting factors are adequate, normal populations should be maintained although burrowing is harder for the mice. On the other hand, if the ease of burrowing is acting as an important limiting factor, it would seem that the soil either could be burrowed in or it could not at any one place. If in the silt loams the soil could less often be burrowed in, then the population reduction there should be due not to a reduction in numbers throughout the area of the silt loam, but to increased areas where the mice could not occur. There should be a greater proportion of plots lacking mice in the silt loams than in the sandy loam. In only 14 of 73 or 19.2% of the plots in the sandy loam were mice of this species absent, while in the silt loams, they were absent in 76 of 143 or 53.1%. This difference was significant (Chi-square = 13.35** 1 df). It is clear that *P. m. bairdi* exists in a much smaller proportion of the area in the silt loams than in the sandy loam. Soil structure or texture might again be the key factor. The sandy loam is coarser; thus, it would be easier to burrow in than the finer, more compact silt loams.

In the case of the house mouse, *Mus musculus*, the situation was quite different. In 116 plots in the silt loams, mice of this species were absent in 30 or 25.9% of the plots, and in the sandy loam they were absent in about the same proportion of plots, or 11 of 42 (26.1%). This indicated that the decreased number of mice in the silt loam is not a matter of exclusion from a major proportion of the area, but rather to decreased populations throughout.

Weedy and Grassy Fields

In weedy and grassy fields, little could be gleaned since the data were so scanty (Table 2). The cover trends again were apparent, with all species except *Peromyscus maniculatus bairdi* being more abundant in better cover (the latter species being more abundant in poorer cover).

The most interesting distribution was that of *Microtus*. *M. ochrogaster*, the common and widespread prairie vole, was found in both good and fair cover in all three soil types, but *M. pennsylvanicus* was found only in good cover and only on the bottom land silt loam. Vigo County is on the edge of the range of *Microtus pennsylvanicus*. The species is common in the northeastern United States, but to the west Hoffmeister and Mohr (2) state that in Illinois "the meadow vole is fairly common in extreme northern Illinois and is known to occur as far south as an imaginary line drawn between Kankakee and Havana." The special combination of factors of good cover in grassy fields on bottom land silt loam would appear, at least in part, to explain why *M. pennsylvanicus* apparently does not occur far westward. This combination of factors, especially with regard to major areas of bottom land silt loam, diminishes to the west of Vigo County. It would be interesting to examine the lower Wabash Valley on the Illinois side of the Wabash River to see how far south *M. pennsylvanicus* extends in the area of the bottom land silt loam. It should be noted that a large number (several hundred) meadow voles, *Microtus pennsylvanicus*, were taken

TABLE 2

Relationship of rodents of grassy and weedy fields to upland and bottom land silt loams in Vigo County, Indiana.

		Good Cover		Fair Cover		Poor Cover	
		7 plots 525 trap- nights		10 plots 750 trap- nights		6 plots 450 trap- nights	
		No./100 Trap- nights		No./100 Trap- nights		No./100 Trap- nights	
		No.		No.		No.	
UPLAND SILT LOAM							
<i>Mus</i>	11	2.10		3	0.40	3	0.67
<i>P. m. bairdi</i>	3	0.57		11	1.47	8	1.78
<i>P. leucopus</i>	6	1.14		5	0.67	0	0.00
<i>M. ochrogaster</i>	10	1.90		1	0.13	0	0.00
<i>M. pennsylvanicus</i>	0	0.00		0	0.00	0	0.00
BOTTOM LAND SILT LOAM							
		12 plots 900 trap- nights		11 plots 825 trap- nights		2 plots 150 trap- nights	
<i>Mus</i>	63	7.00		8	0.97	0	0.00
<i>P. m. bairdi</i>	8	0.89		9	1.09	4	2.67
<i>P. leucopus</i>	36	4.00		6	0.73	1	0.67
<i>M. ochrogaster</i>	10	1.11		4	0.48	0	0.00
<i>M. pennsylvanicus</i>	19	2.11		0	0.00	0	0.00

in Vigo County about one mile east of the Illinois line in the valley of Clear Creek. Clear Creek originates in Illinois and flows eastward through Vigo County, Indiana, into the Wabash River. Eight mice of this species also were taken in the Clear Creek valley in Illinois just west of the state line, thus constituting an Illinois record about 80 miles south of the Kankakee-Havana line.

Wooded Situations

The only species taken in great enough numbers to accumulate meaningful information in the wooded situations was *Peromyscus leucopus*. Likewise, meaningful numbers of plots occurred only in the two types of silt loam (Table 3).

Overall, 3.44 mice of this species per 100 trap-nights were taken on the bottom land silt loam, and only 1.86 on the upland silt loam. This difference is significant (Chi-square = 10.34, 1 df). There is a direct relationship between the number of mice of this species and the amount

TABLE 3

Occurrence of *Peromyscus leucopus* in woodland areas on the upland and bottom land silt loams of Vigo County, Indiana.

	Good Cover	Fair Cover	Poor Cover
UPLAND SILT LOAM			
Plots	0	10	23
Trap-nights		750	1725
<i>P. leucopus</i> , no.		16	30
No./100 trap-nights		213	1.73
BOTTOM LAND SILT LOAM			
Plots	6	9	9
Trap-nights	450	675	675
<i>P. leucopus</i> , no.	30	25	7
No./100 trap-nights	6.67	3.70	1.04

of herbaceous ground cover (5). The difference in cover probably explains the difference in abundance of *P. leucopus* on the two soil types. Of 33 plots on the upland silt loam, none had good cover, while of 24 plots on the bottom land silt loam, six or 25 per cent had good cover. This difference was not significant (Chi-square = 0.97, 1 df), but again this was thought to be due to the small sample size.

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