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Habitat Selection by Small Mammals in an Urban Woodlot[1]

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ABSTRACT

Removal trapping was used to identify which of 27 habitat variables were important to each of 5 small mammal species inhabiting an urban woodlot and an adjacent field. *Microtus pinetorum* selected wooded areas with high vertical vegetative stratification, with an abundance of evergreen shrubs and ground cover, and with many long logs. *Microtus pennsylvanicus* and *M. ochrogaster* selected areas dominated by grass and sedge vegetation. *Peromyscus leucopus* was captured in close proximity to trees in both wooded and field habitats. Logs were habitat characteristics important to *Blarina brevicauda* captures.

INTRODUCTION

Many techniques have been employed to study segregation of small mammal species within an environment. Hamilton (1) tried to describe habitats of small mammals by indigenous plant taxa. Ambrose (2) studied movements of *M. pennsylvanicus* in pens that simulated their natural habitat. His studies indicated that flexibility in habitat utilization would allow modification in the animal's behavior according to local environmental conditions (2).

Recent studies have shifted emphasis to the determination of structure and composition of microhabitats. Dueser and Shugart (3, 4) employed statistical analysis of structural variables to determine microhabitats and niche overlap among small mammal species. The distribution of vegetative strata was used to describe the distribution of *Peromyscus leucopus* (5). Food abundance, nesting sites, and complexity of escape routes also acted as deterministic factors in the distribution of *P. leucopus* (5). Stages and growth forms of vegetation have been considered to be of primary importance in determining small mammal distribution and density (6, 7, 8, 9).

The objective of our study was to quantify microhabitat differences among small mammal species in an urban woodlot and in an adjacent field, and to identify the environmental variables that would distinguish among the preferred microhabitats for species within the small mammal community.

MATERIALS AND METHODS

The study area was Shady Lane Woods, a 6-ha undisturbed tract in the southwest section of the University of Kentucky campus, Lexington. The area consists of two adjacent but different habitats: one dominated by *Poa pratensis*, *Festuca* spp., *Carex* spp. with a partial *Juglans nigra* overstory, and another of mixed hardwoods (*J. nigra*, *Celtis occidentalis*, and *Gymnocladus dioicus*) with ground cover ranging from sparse herbs to dense *Euonymus fortunei*, *E. americanus* and *Symphoricarpos orbiculatus*.

A grid system of 50 points (5 rows of 10 points) was established to equally sample both the field and the forest. Intersection points on the grid were 8 m apart. One tree was present in the field portion of the study area, and the field was partially covered by the canopies of 2 adjacent trees as well as by the trees at the wood's edge.

Following unacceptable capture efficiency with pitfall traps and live traps, 4

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snap traps (2 mouse traps, 2 Museum Specials) were distributed per grid point, with emphasis on placing the traps on existing mammal runs within 1.5 m of the plot point. Peanut butter and cotton were used as bait.

Trapping was conducted for 3 periods during 1981: 24 May to 5 June, 21 July to 23 July, and 11 September to 14 September. For purposes of calculation, the second and third capture periods were combined into 1 period since they were each of short duration; the periods were similar in weather, and summer herbaceous vegetation dominated during that time. The traps were checked twice a day: 0700 and 1900 hours.

Habitat characteristics that do not vary seasonally (tree, log, snag and stump characteristics) were measured at each grid point in March and April, 1981. Vegetative cover, stem density, and leaf cover were measured in May 1981 and were used to describe the first trapping period. The characteristics that changed seasonally were remeasured in July and considered representative of the habitat during the second and third trapping periods. A detailed description of habitat variables and measurement techniques is found in Table 3.

Linear correlation was used to determine association of habitat variables with the number of small mammal captures. A t-test was used to compare mean habitat variables for plots where captures were made with means for plots where captures were not made.

RESULTS

During the 2 trapping periods, 99 captures were made: 37 *Microtus pinetorum*, 8 *Blarina brevicauda*, and 6 *Peromyscus leucopus* during the first period and 23 *M. pinetorum*, 10 *M. pennsylvanicus*, 9 *P. leucopus*, 3 *B. brevicauda*, and 3 *M. ochrogaster* during the second period. Captures were made on 41 of the 50 grid points. Multiple captures were made on 15 grid points. Animals were captured on 27 of the 50 plots during the first trapping period, and on 16 plots in the second period.

Microtus pinetorum.—*Microtus pinetorum* was captured more often in the woods (44) than in the field (16) ($P < 0.05$) but 11 were caught in the field and 13 in the woods during the second trapping period. *Microtus pinetorum* was trapped at 20 of the 25 points in the woods with a maximum of 6 captures made at each of 2 woods points. In the field, *M. pinetorum* was taken at 10 points with multiple captures at 4 points.

Of 27 habitat variables considered for *M. pinetorum*, 15 showed significant correlation to capture site during the first trapping period, but no variable showed significant correlation during the second trapping period due to randomness of *M. pinetorum* captures. Of the variables that showed correlation during the first period, tree characteristics dominated (Table 1). Positive correlations were obtained for height of overstory ($P < 0.01$), midstory ($P < 0.01$), and understory trees ($P < 0.05$); per cent of canopy cover ($P < 0.05$); and foliage height diversity ($P < 0.05$). Captures were negatively correlated ($P < 0.05$) with distance to the nearest tree. Results of the t-tests on these variables yielded similar results (Table 1). *Microtus pinetorum* showed its preference for the woods by its negative correlation with major field variables: per cent of grass cover ($P < 0.1$), density of herbaceous cover ($P < 0.1$), and number of herb species ($P < 0.01$) (Table 1). Percentage of non-deciduous plant cover influenced the distribution of *M. pinetorum*; evergreenness of shrubs ($P < 0.001$), ground cover ($P < 0.01$), and herbs ($P < 0.05$) were positively correlated with captures of *M. pinetorum*. The t-test results indicate that a preponderance of evergreen ground cover (*E. fortunei*, *E. americanus*, and *S. orbiculatus*) was the most influential variable of the 3.

Finally, *M. pinetorum* showed preference for logs in the environment. Captures showed positive correlation with log diameter ($P < 0.001$) and log density ($P < 0.001$), and negative correlation with distance to the nearest log ($P < 0.001$).

Microtus pennsylvanicus.—*Microtus pennsylvanicus* exhibited a preference for

TABLE 1.—MEANS AND STANDARD DEVIATIONS FOR POINTS WITHOUT CAPTURES VERSUS POINTS WITH CAPTURES, $P > (t)$, AND COEFFICIENTS OF CORRELATION (r) FOR HABITAT VARIABLES OF *Microtus pinetorum*

Variable	Non-captures (N = 20) ($\bar{x} \pm s$)	Capture (N = 30) ($\bar{x} \pm s$)	$P > (t)$	r
Overstory tree height (m)	7.2 ± 11.0	14.3 ± 11.8	0.04	0.373*
Midstory tree height (m)	3.3 ± 4.9	6.8 ± 4.9	0.02	0.420*
Understory tree height (m)	1.0 ± 1.3	2.5 ± 1.8	0.002	0.323*
Canopy cover (%)	62.8 ± 36.9	82.4 ± 27.2	0.05	0.300*
Foliage height diversity	1.0 ± 0.4	1.2 ± 0.3	0.04	0.302*
Tree distance (m)	8.2 ± 7.4	2.5 ± 2.5	0.0004	−0.349*
Grass cover (%)	52.7 ± 34.0	26.1 ± 32.6	0.009	−0.436*
Number of herb species	16.0 ± 5.7	11.4 ± 3.2	0.0007	−0.368*
Herb stem density/4 m^2	385.6 ± 217.8	177.8 ± 189.4	0.002	−0.427*
Evergreenness of shrubs (%)	1.1 ± 2.4	4.2 ± 4.7	0.02	0.480**
Evergreenness of herbs (%)	23.8 ± 28.9	48.8 ± 35.8	0.01	0.281*
Evergreenness of ground cover (%)	47.4 ± 35.8	78.1 ± 32.3	0.004	0.444*
Log diameter (cm)	4.4 ± 6.5	11.6 ± 6.2	0.0003	0.462**
Log density/4 m^2	0.6 ± 1.0	1.8 ± 1.4	0.0007	0.454**
Log distance (m)	13.8 ± 8.6	6.4 ± 6.7	0.003	−0.424*

* $P < 0.05$.
** $P < 0.001$.

the field in this study. Ten *M. pennsylvanicus* were taken at 5 of the 25 fieldpoints. Capture points had a lesser per cent canopy cover ($P < 0.001$), and they were farther from trees ($P < 0.005$) than points without captures. Capture points also had lower evergreen ground cover ($P < 0.0001$), and denser herbaceous ground cover ($P < 0.001$) than non-capture points.

Correlations between the number of captures per point and habitat variables influencing captures were more difficult to make because of the small sample size and the positions of points where captures were made (Table 2). Variables measuring stratification of vegetation at the points, canopy cover ($P < 0.001$) and foliage height diversity ($P < 0.001$), were negatively correlated with *M. pennsylvanicus* captures. Captures were also negatively correlated with the following variables characteristic of woods: density of woody stems ($P < 0.05$), number of woody stems ($P < 0.05$), percentage of evergreen herbs ($P < 0.05$), and ground cover ($P < 0.01$).

Other Species.—Three other species of small mammals were captured during this study: *P. leucopus, B. brevicauda,* and *M.*

TABLE 2.—MEANS AND STANDARD DEVIATIONS FOR POINTS WITHOUT CAPTURES VERSUS POINTS WITH CAPTURES, $P > (t)$, AND COEFFICIENTS OF CORRELATION (r) FOR HABITAT VARIABLES OF *Microtus pennsylvanicus*

Variable	Non-captures (N = 45) ($\bar{x} \pm s$)	Capture (N = 5) ($\bar{x} \pm s$)	$P > (t)$	r
Canopy cover (%)	75.6 ± 31.4	17.8 ± 22.0	0.0001	−0.465**
Foliage height diversity	1.1 ± 0.3	0.5 ± 0.3	0.0003	−0.430*
Tree distance (m)	5.4 ± 6.3	12.8 ± 7.9	0.02	0.242
Number of woody species	5.4 ± 3.7	0.3 ± 0.5	0.0001	−0.356*
Woody stem density/4 m^2	22.4 ± 19.9	4.2 ± 10.2	0.04	−0.270*
Evergreenness of herbs (%)	36.8 ± 33.7	1.7 ± 1.6	0.0001	−0.270*
Evergreenness of ground cover (%)	63.8 ± 36.1	13.3 ± 12.2	0.0001	−0.435*
Ground cover (%)	74.1 ± 30.0	98.3 ± 4.1	0.0001	−0.227

* $P < 0.05$.
** $P < 0.001$.

TABLE 3.—DESIGNATION, DESCRIPTIONS, AND SAMPLING METHODS OF 27 VARIABLES MEASURING FOREST HABITAT STRUCTURE

Variable	Methods
1) Per cent canopy cover	Per cent of overstory vegetation coverage above a 1.0 m radius circle around plot center.
2) Per cent ground cover	Percentage of soil covered by vegetation within a 1.0 m radius circle around plot center.
3) Per cent shrub cover	Same as (1) for shrub-level vegetation.
4) Overstory tree height	Height in m of the nearest overstory tree.
5) Midstory tree height	Height in m of the nearest midstory tree.
6) Understory tree height	Height in m of the nearest understory tree.
7) Number of woody species	Woody species count within a 1.0 m radius circle around point center.
8) Number of herbaceous species	Same as (7) for herbaceous species.
9) Woody stem density	Live woody stem count within a 1.0 m radius circle around point center.
10) Herbaceous stem density	Same as (9) for herbaceous stems.
11) Tree stump density	Largest diameter in cm of the nearest tree stump.
12) Tree stump distance	Distance in m to the nearest tree stump.
13) Log diameter	Largest diameter in cm of the nearest fallen log (>10.0 cm diameter).
14) Log length	Length in m of the nearest fallen log (>10.0 cm diameter).
15) Log density	Same as (9) for fallen logs (≥10.0 cm diameter).
16) Log distance	Distance in m to the nearest fallen log (≥10.0 cm diameter).
17) Snag diameter	Diameter in cm at breast height of the nearest dead tree (>10.0 cm).
18) Snag distance	Distance in m to the nearest dead tree.
19) Tree diameter	Diameter in cm at breast height of the nearest tree (≥10.0 cm diameter).
20) Tree distance	Same as (18) for distance to the nearest tree.
21) Number of tree species	Same as (7) for tree species.
22) Leaf litter	Greatest depth in cm of leaf litter within a 1.0 m radius circle around plot center.
23) Per cent of grass cover	Same as (2) for grasses.
24) Evergreenness of shrubs	Same as (1) for evergreen shrub-level vegetation.
25) Evergreenness of herbs	Same as (2) for herbaceous vegetation.
26) Evergreenness of ground cover	Same as (2) for ground cover.
27) Foliage height diversity	Foliage height diversity index (19) calculated from the following formula: $FHD = 3.3219(\log N - (1/N(n_o \log n_o + n_m \log n_m + n_u \log n_u)))$ where n_o = per cent overstory cover, n_m = per cent midstory cover, n_u = per cent understory cover, and $N = n_o + n_m + n_u$.

ochrogaster. *Peromyscus leucopus* was captured 15 times during the study, 6 times during the first capture period and 9 times during the second period. *Blarina brevicauda* was taken 11 times, 8 during the first sample period and 3 in the second period. Only 3 *M. ochrogaster* were captured, all during the second period, and all were taken in the field.

Peromyscus leucopus has been characterized as a species preferring a shrubland-woodland habitat (5, 10), but we caught more *P. leucopus* in the field than in the woods. The per cent canopy cover was the only variable that showed correlation with capture ($P < 0.05$) in both sample periods. The points where *P. leucopus* were taken in the field indicated its preference for trees since every capture site was within 8 m of a tree.

Blarina brevicauda was an ubiquitous species that showed no preference for a specific type of vegetation. They have been taken in vegetation types ranging from grasslike to forested (11, 12). Captures of *B. brevicauda* were positively correlated with log length ($P < 0.05$), probably because invertebrates could be found in greater numbers there.

Only 3 *M. ochrogaster* were taken during the study. However, these 3 captures substantiated the available literature on the prairie vole; it is a species of grassy fields (7, 13, 14).

DISCUSSION

Microtus pinetorum captures were correlated with tree variables, reflecting the predominance of captures in the woods. They occurred at sites with thick canopy cover, adjacent trees, and high tree species diversity and showed preference for sites of vegetative strata diversity. Life forms of vegetation influenced selection of habitat by *M. pinetorum*. Variables that consider life forms rather than taxa have been shown to be most important in *M. pinetorum* habitat selection (8). This species preferred sites with a preponderance of evergreen vegetation. Woody and herbaceous plants have more water available during the growing season than grasses. Benton (15) reported that *M. pinetorum* is not dependent on water to any degree in nature; the species thrives in captivity without water if succulent food is supplied. It is reported to feed on succulent roots and tubers in nature (1). *Microtus pinetorum* also occurred at sites with fallen logs. Log diameter, density, and distance were important habitat features. Microtine runs were observed along fallen logs; *M. pinetorum* will nest under fallen logs (13).

Microtus pennsylvanicus segregated itself from *M. pinetorum* by its selection of field characteristics, occurring at sites with dense grass. Many studies have shown *M. pennsylvanicus* to prefer grass-like herbaceous cover (6, 9, 16, 17), while avoiding areas where woody plants predominate (18).

The number of captures of other species was low, but general trends were discerned. *Peromyscus leucopus* showed a preference for points with trees in the vicinity, *Blarina brevicauda* showed a preference for long logs; and *M. ochrogaster* preferred grassy habitats.

The results of this study indicate that habitat characteristics selected by small mammals in an urban woodlot were similar to characteristics reported in previous studies for each species in rural areas. The location of the woodlot in an urban environment had no obvious effect on habitat selection by indigenous small mammals. Shady Lane Woods offers unique opportunities to study sympatric small mammal species in an urban setting because of its diverse habitats and high species richness of small mammals.

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