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Seasonal Variations in Movements and Habitat Use by Pine and Meadow Voles

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Abstract: Free-ranging pine voles (Microtus pinetorum) and meadow voles (M. pennsylvanicus) were radiotracked in a maintained apple orchard environment in August and December 1980. Meadow voles maintained larger home ranges than pine voles in the summer, but had similar-sized ranges in December. The home ranges for both species decreased with the onset of winter. Pine and meadow voles showed a strong tendency to remain within rows and to restrict most of their movement to areas beneath the canopy. Despite some overlap in space use between the species, the movements of both vole species suggested mutual avoidance. Differences in habitat utilization between pine and meadow voles was also suggested.

INTRODUCTION

This study focuses on the interactions of the two vole species generally co-inhabiting the orchards of the Hudson Valley, New York, namely the pine vole (Microtus pinetorum) and the meadow vole (M. pennsylvanicus). Movement and habitat use data are being collected on a seasonal basis using radiotelemetry techniques as a primary research tool. The main purpose of the research is to gather information that will aid in the development of a vole management program.

METHODS

Site Selection

Choice of a specific research site was based on heterogeneity. The 0.7 habitat site chosen consists of eight rows with sixteen trees in each row. Row spacing is 11 meters and tree spacing is 5 meters. Trees range from five years to greater than thirty years in age. Odd numbered rows have trees greater than thirty years old alternating with interplants five to ten years old. Even numbered rows include trees twenty years old or younger. The vegetation and soil variables measured on the site show considerable variability as well.

Under the above circumstances, it was hypothesized that the two vole species would be more likely to make choices and show habitat preferences, and any tendency for pine and meadow voles to separate would be more evident.

Trapping and Telemetry

Trapping was conducted monthly to collect population data and once a season to collect animals for radiotelemetry. Two traps were placed at every other tree for four checks over a two day period. The traps were then shifted to the alternate trees for checks over another two day period.

Animals selected for the telemetry work were taken to a field station where radiotransmitters were surgically implanted in the intraperitoneal cavity (see Madison et al. in this issue for details regarding equipment and methodology). The animals were then released at the position of capture within twenty-four hours of surgery. After a several day recovery peiod, radiotracking was begun.

Seasonal radiotelemetry sessions were comprised of three twenty-four hour periods. Each twenty-four hour period consisted of three different eight hour segments, each segment being monitored once during a 48 hour period. Thus, a twenty-four hour cycle was completed in two days. All animals were located every half-hour. It was felt that this sampling regime should give an adequate sample of data points to obtain representative movement and habitat use patters for each animal.

Only adult females were used during the telemetry sessions. The decision to use only females was based on the observations that female meadow voles have more stable home ranges than males (Madison, 1980), and thus would have more definitive habitat use patterns. Pine voles appear to have no great sexual differences in movement patterns (FitzGerald and Madison, these proceedings), but only female pine voles were used in order to keep methods standardized for the two species.

Habitat

Figure 1 is a schematic representation of the collection of habitat data. Measurements for each soil and vegetation variable were taken one meter from the base of the tree. Four sampling points were located around each tree on the study site as shown in the diagram. The triangles represent the areas of effect for each habitat sampling point. Telemetry positions falling in any one of the triangles take on the particular habitat values obtained at that sampling point.

The habitat variables included in this study are as follows (see McAninch, 1979, for details):

Tree
- Age
- Canopy Coverage
- Density (Light Reception)

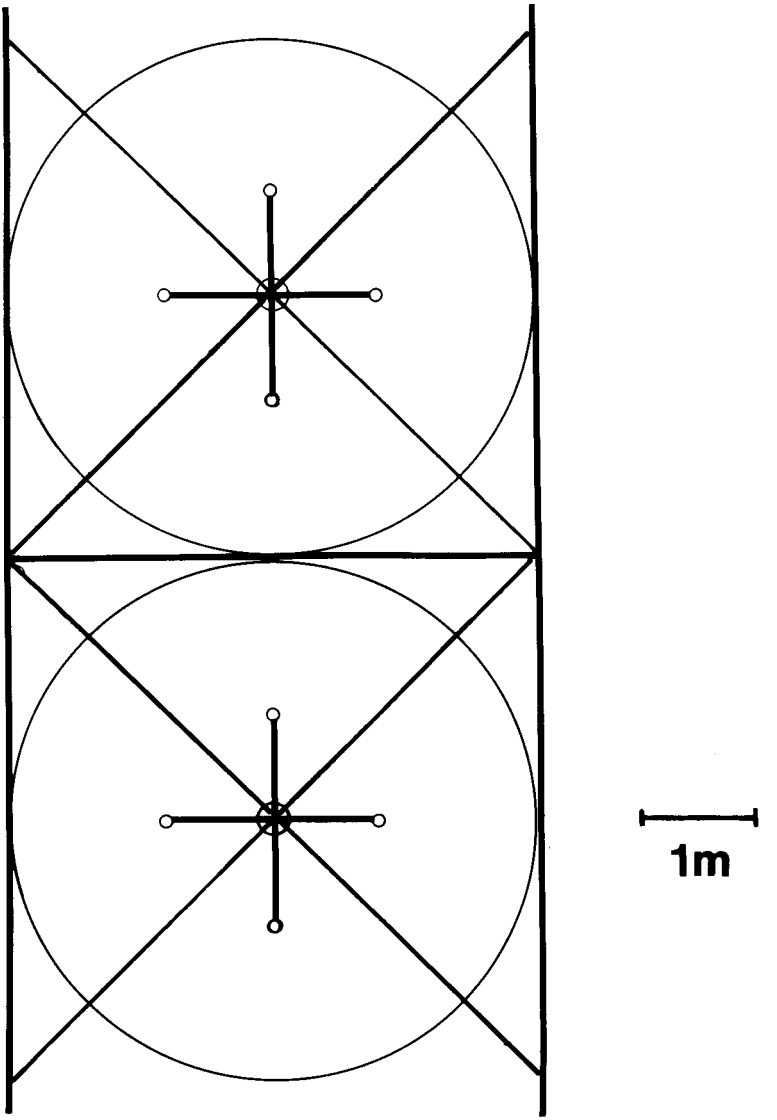

Figure 1: Schematic diagram representing the methods of habitat data collection. Sampling points are indicated by the small circles; the tree trunk, by the medium sized circles; and the canopy, by the largest circles. See text for further explanation.

Soil
- Organic Matter
- Moisture
- pH
- Compaction
- Litter Depth
- Litter Composition

Vegetation
- Ground Cover
  - Composition
  - Coverage
  - Horizontal Density
  - Debris

Statistical Analysis

Regression analysis was performed on the habitat and telemetry data. Correlations were obtained by regressing the telemetry positions for each species on the values for each habitat variable. The correlation coefficients were then tested for statistical significance and assigned "+" values (for positive correlation), "-" values (for negative correlations), or "0" values (for no correlation). The meadow and pine voles were then compared on a relative basis for any differences in habitat preferences.

RESULTS AND DISCUSSION

Movements

Two telemetry sessions have been completed thus far. The first was conducted in late August, 1980 and the second in early December, 1980. Comparisons of movement patterns of the two vole species and the seasonal changes that occur are shown in Table 1. Home range areas were calculated using the 100% minimum polygon method as described by Michener (1979).

Table 1: Movements and average home range size for female meadow and pine voles during August and December telemetry sessions.

Season	Vole Species	No. Voles Analyzed	Telemetry[1] Positions	Row Crossings	Home Range (m^2)
Aug.	Meadow	3	120	12	66.7 ± 3.0
	Pine	3	144	2	40.3 ± 2.0
Dec.	Meadow	5	577	2	17.0 ± 0.8
	Pine	6	700	0	18.6 ± 0.9

[1]The Discrepancy between August and December in the total number of telemetry positons obtained for each vole species was casued by battery failure, a problem which has since been corrected.

Table 1 shows row crossings to be a rare event. During August one individual accounted for all twelve of the meadow vole crossings. Pine voles rarely crossed rows. In December there was virtually no crossing of rows for either species as compared to the total number of positions obtained per species. The low frequency of movement across rows for both seasons indicates a stong within row orientation for female pine and meadow voles.

Table 1 also shows that female meadow voles maintain larger home ranges than female pine voles in the late summer, but in December the ranges of the two are practically the same. In addition, home range size decreased considerably for females of both species with the onset of winter. This information is visually represented in Figures 2 and 3. The decrease in home range area could be due to a change in food supply, a decrease in reproductive activity, climatic changes, or a combination of these factors.

During August considerable overlap occurred among three female voles in the area of one tree (Fig. 2). Two pine voles, while not overlapping to any great extent themselves, enveloped nearly all of a single meadow vole home range. Although they utilized many of the same areas, the three individuals were never located in the same 2 m^2 area at the same time.

Two cases of overlap occurred between female pine and meadow voles during the December telemetry (Fig. 3). These voles overlapped (within the same 2 m^2 area at the same time) during only 5% of the telemetry positions recorded for these individuals. However, in one case the pine vole and meadow vole were not separable by time or horizontal distance.

The data suggests a possible mutual avoidance between pine and meadow voles. Although overlap of home ranges does exist, females of the two species appear to avoid contact. Further study is needed on the possible separation of female pine and meadow voles in time or space. Space in this sense includes both horizontal and vertical components.

Habitat Use

Possible explanations for seasonal changes and interspecific differences in movement patterns could lie in habitat factors. One such factor is the area covered by the tree canopy. A striking characteristic of a mature apple tree is the extent of influence of its canopy.

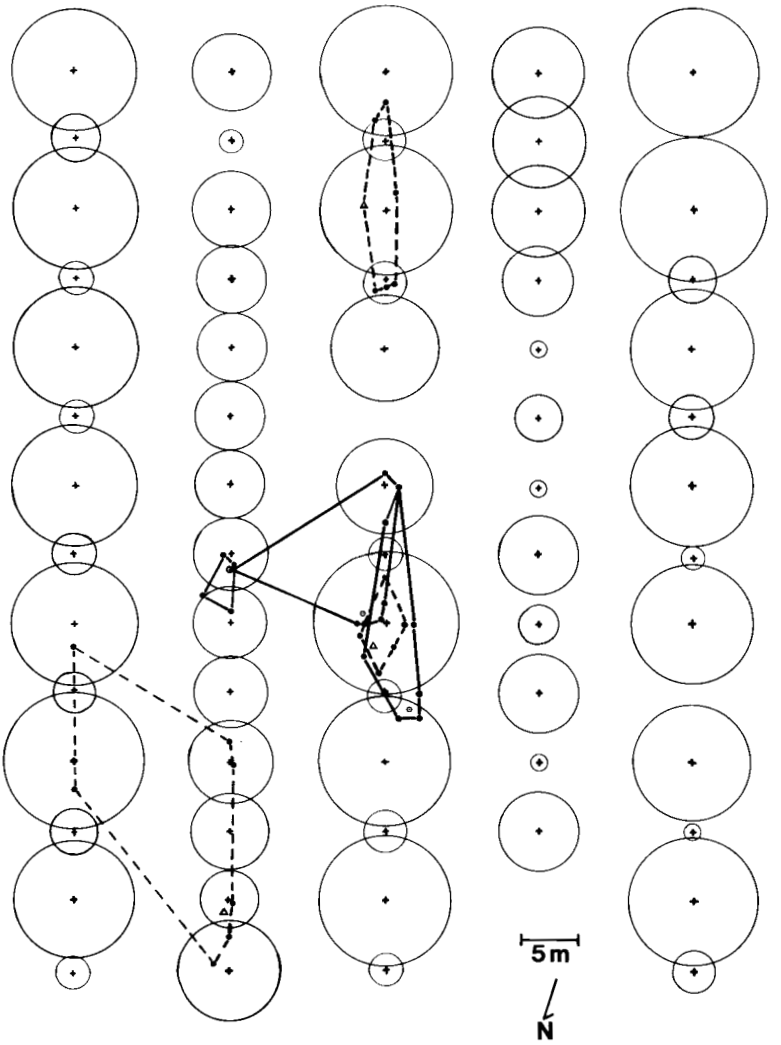

Figure 2: August telemetry data. Pine vole home ranges are indicated by solid lines; nests, by circles with dot. Meadow vole home ranges are indicated by broken lines; nests, by open triangles. Crosses represent tree locations and large circles are measured tree canopies.

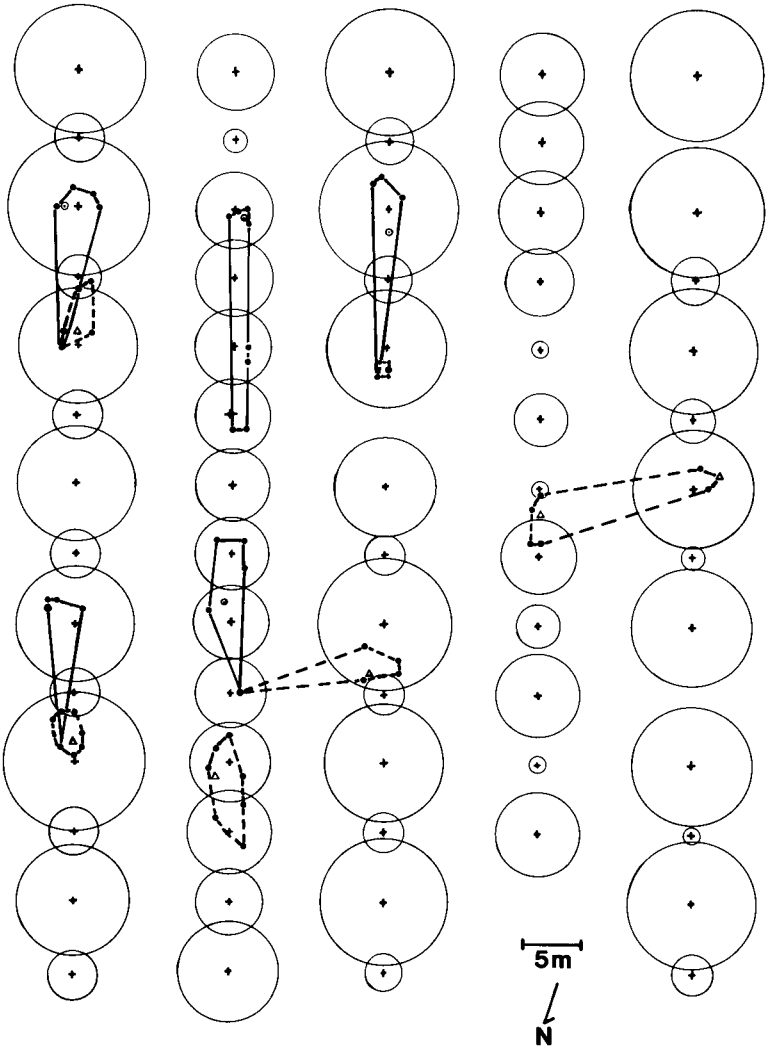

Figure 3: December telemetry data. Pine vole home ranges are indicated by solid lines; nests, by circles with dot. Meadow vole home ranges are indicated by broken lines; nests, by open triangles. Crosses represent tree locations and large circles are measured tree canopies.

Two of the three pine voles, for a combined total of 21 positions, moved outside the canopy corridor in August. This represents about 15% of the total pine vole positons obtained for the first telemetry session. Meadow voles remained entirely within the canopy area. During December one meadow vole accounted for all 57 telemetry positions falling outside of the canopy covered areas, which is about 10% of the total positions obtained for meadow voles. No positions were obtained for pine voles outside of the canopy covered areas at this time. Although during both telemetry sessions animals did cross rows, no positions were actually located in the aisles between rows.

Again the data suggest a strong within row orientation for females of both species. It appears as though canopy coverage is of more importance to the pine and meadow voles than actual age of the tree under which they are found. Although an individual might be found under a young interplant, the vole could still be within the influence of an older tree due to the extent of the tree's canopy.

Female pine and meadow voles appear to use certain habitat characteristics differently (Tables 2 and 3). During August, pine and meadow voles showed a negative correlation with grass cover, but differed in their use of forb cover. These results could be due to a seasonal change in food and/or cover availability, with grasses maturing in early summer and giving way to forbs in August.

Table 2: Correlation coefficients between vole distribution and habitat characteristics for August. Positive correlation +; Negative correlation -; and No correlation 0. All values were tested at the .05 level of significance. Df for meadow voles = 118 and pine voles = 142.

Habitat Variable	Meadow Vole Correlation	Pine Vole Correlation
Ground Cover: Grass	- (-0.41)	- (-0.15)
Ground Cover: Forbs	+ (0.42)	0 (0.04)
Ground Cover: Bare Ground	+ (0.48)	+ (0.59)
Soil Compaction	- (-0.34)	- (-0.42)
Horizontal Veg. Dens., 0-25 cm	+ (0.70)	- (-0.18)
Horizontal Veg. Dens., 0-1 m	+ (0.22)	+ (0.26)
Ground Litter Depth	0 (0.05)	+ (0.85)

Also from Table 2, meadow voles show a positive correlation with horizontal vegetation density from 0-25 cm, but have no correlation with ground litter depth. Pine voles, on the other hand, had only a slight preference for areas of less horizontal vegetation density (0-25 cm) but were strongly attracted to areas of greater ground litter depth. This could be related to the surface orientation of

the meadow vole and the requirement of a dense vegetative cover through which it can move and feed. The more fossorial pine vole may not require the heavy vegetative cover for protection or food, yet desire ground litter as a cover under which they can burrow.

As indicated by the correlations with soil compaction, both species also prefer looser soils in which they can burrow and form runways. Telemetry work suggests that both species utilize underground runways. Direct observations indicate that meadow voles as well as pine voles construct underground tunnel systems, although the extent of burrowing for each species may differ.

Several habitat variables studied in August were not applicable in December due to the change in seasons. From Table 3, however, it is evident that a seasonal shift in preference occurred in at least one habitat variable. Meadow voles, in December, shifted to a slightly negative correlation with horizontal vegetation density (0-25 cm), while pine voles at the same time showed no preference for high or low values. This could be related to the fact that most of the above ground vegetation had died by December.

The two species showed no change in preference for ground litter depth between seasons, except that pine voles did not show quite as strong a positive correlation as in August. Although having a positive correlation with ground litter depth, the movements of pine voles tended to be away from areas with a higher percentage of leaf cover. Meadow voles showed a slight positive correlation with leaf litter.

Apple drops during the late summer and autumn supply a good source of moisture and food. Pine voles appeared to prefer areas with greater numbers of apples; meadow voles showed only a weak positive correlation. The number of apples found on the ground in any location can be directly related to the age and productivity of the trees in the immediate vicinity. However, such correlations as found between the voles and apple drops could very well be related to other preferred habitat characteristics chosen prior to fruit maturation.

Table 3: Correlation coefficients between vole distribution and habitat characteristics for December. Positive correlation +; negative correlation -; and No correlation 0. All values were tested at the .05 level of significance. Df for meadow voles = 575 and for pine voles = 698.

Habitat Variable	Meadow Vole Correlation	Pine Vole Correlation
Ground Cover: Leaf Litter	+ (0.23)	- (-0.52)
Horizontal Veg. Dens., 0-25 cm	- (-0.16)	0 (0.02)
Ground Litter Depth	0 (0.01)	+ (0.21)
Apple Count	+ (0.15)	+ (0.46)

The results presented here are only preliminary findings, and further analysis will be conducted on the data in the future. What has been learned to this point will aid in the collection of data during the second field season. One area of importance that needs further study is the possibility that females of the two species are mutually avoiding each other in time and/or space. The results shown here also suggest possible differences between pine and meadow voles in habitat use patterns. A closer look at such habitat variables as ground cover composition, horizontal vegetation density, and ground litter depth is needed.

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