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RADIOTELEMETRIC EVALUATION OF THE EFFECT OF HORTICULTURAL PRACTICES ON PINE AND MEADOW VOLES IN APPLE ORCHARDS: III. USE OF ORCHARD BORDER HABITATS BY MEADOW VOLES

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Abstract: A study was undertaken to determine if meadow voles, Microtus pennsylvanicus, use habitats adjacent to apple orchards. Considerations were given to how extensively these areas were used, if at all, and if a bulldozed strip would control their movements between the orchard and adjacent border habitats. Trapping and telemetry data showed that meadow voles do use the adjacent border habitats extensively and make frequent crossings between these areas and the nearby orchards. It would seem, therefore, important to include these areas in any vole management program. Although the bulldozed strip was effective in reducing movements between the orchard and adjacent habitat types, questions remain as to the optimal method of controlling any movement.

INTRODUCTION

A major concern of the orchard growers of the Hudson Valley has been the reinvasion of an orchard whose vole population has been eliminated or controlled. Hamilton (1935) indicated that meadow voles used brush piles, weedy corners, and other borders near orchards. These individuals could act as "seed" populations that might ultimately invade the orchards. Thus, it would be important to identify such sources, if they exist, and include these habitats in any overall vole management program.

Four main questions were posed prior to the initiation of the field work. First, do meadow voles use habitats that are adjacent to many of the orchards? Second, to what extent do meadow voles use this border-refuge habitat? Third, how extensive are any movements between the orchard and border habitats? Finally, what effect would a boundary strip have on movement patterns between the orchard and border areas?

METHODS

The study site was located on the Steve Clarke farm near Modena, New York in the Hudson Valley. A trapping grid was set up along an orchard edge bordering a wet hollow dominated by thick brush and woody vegetation. A grass strip 5 m wide separated the orchard from the brush and will hereafter be called the edge.

The trapping grid consisted of 90 Sherman live traps set in 15 rows with six stations per row (Figure 1). One trap was placed at

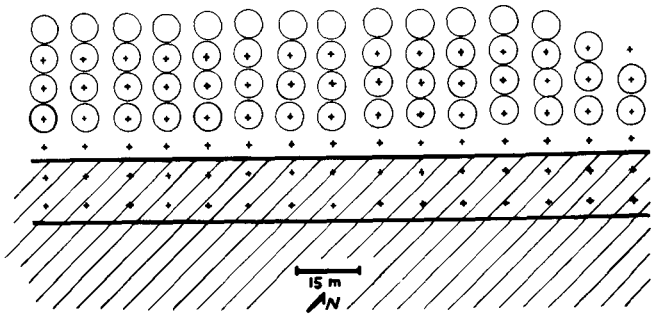

Figure 1: Diagram of the study site, showing apple trees (0), trap locations (+), and the brush habitat (///). The two heavy horizontal lines enclose the bulldozed zone.

each station. Traps were spaced 7 m apart within rows and 10 m apart between rows as dictated by tree spacing. The grid was situated so that three stations in every row were in the orchard, one station was in the edge, and two were in the brush. Three trap checks were conducted over a two-day period for a total of 270 trap checks. At the conclusion of the study, a three-day trap out was conducted to retrieve transmitters and remove all animals present.

Telemetry equipment and methods used were similar to those described in earlier papers (Madison, et al., 1980). Four adult male meadow voles and five adult females were selected from the animals trapped for use in the telemetry work. These animals came primarily from orchard trap sites. All male meadow voles were reproductively active, and all females were at the same stage of pregnancy at the time of transmitter implant.

Telemetry positions were obtained hourly for eight consecutive hours on each of three days for every individual. After an initial 25 positions were obtained, a bulldozed strip 15 m wide was made in the brush. The 5 m wide edge was left untouched, creating a total

distance of 20 m between the orchard and the edge of the brush. Twenty-five telemetry positions were again obtained on each individual in the same manner as described above. The data were combined (males plus females) for analysis.

RESULTS

The trapping results shown in Table 1 indicate that the meadow voles used all three areas found within the study site. For the size of the area involved, a disproportionately high number of voles were caught in the mowed edge habitat. The results of the trapping suggested a justification to continue with the project despite the fewer captures in the brush zone.

Table 1: Trapping data indicating the number of different individuals caught in each habitat type.

	Sex			Total
	M	F	Total	Trap Checks
Orchard	5	6	11	135
Edge	7	3	10	45
Brush	4	2	6	90

Animals caught in one habitat type did not necessarily restrict their movements to that area. Six of the nine transmittered voles included both the brush and orchard habitats within their home ranges. These animals freely crossed the grassy edge before the bulldozed strip was created between the orchard and brush zones.

The telemetry data presented in Table 2 are adjusted values, obtained by multiplying the raw data by coefficients to reflect the size of the three habitat types on the study sites. The total telemetry positions for the edge, brush, and orchard were multiplied by .17, .33, and .50, respectively. The data are summarized as mean telemetry positions per habitat type before and after bulldozing.

Table 2: Telemetry data summarized as mean positions per area before and after bulldozing. The telemetry data was adjusted by coefficients to reflect the size differences between the habitat types (the coefficients were .17 for edge, .33 for brush, and .50 for orchard).

	Orchard	Edge	Brush
Before	3.17	0.28	5.41
After	4.17	0.08	3.21

A two-way analysis of variance was carried out on the telemetry data. No statistically significant differences existed between before and after bulldozing; however, the area main effect was significant ($p < .01$). A Neuman-Keuls multiple range test showed that brush and orchard zones were used similarly, but the edge was used significantly less than either the brush or orchard ($p < .05$).

As an indicator of mobility between the brush and orchard areas, the number of complete crossings from the brush into the orchard habitat (or vice versa) was tabulated both before and after the bulldozing for each meadow vole (Table 3). All but two of the nine animals carrying transmitters made crossing moves before the manipulation. During the bulldozing operation, considerable movement occurred as nearly every transmittered vole had to move away from the bulldozer. However, only one female meadow vole carrying a transmitter was killed as a direct result of the bulldozing. A t-test showed a statistically significant difference in crossings before vs. after bulldozing ($t = 3.48$, $p < .05$). Substantively, there appears to be a distinct decrease in the number of crossings after the bulldozing.

Table 3: The number of crossings from the orchard to the brush (or vice versa) by individual meadow voles before and after bulldozing.

	Number of Crossings	
Vole	Before	After
1	0	0
2	3	1
3	6	1
4	6	1
5	2	1
6	4	0
7	6	1
	$\bar{X} = 3.86$	$\bar{X} = 0.71$

DISCUSSION

The main purpose of this study was to determine if habitats found adjacent to orchards were used by meadow voles. The trapping and telemetry data not only show that some meadow voles use the brush as part of their home ranges, but that they use it just as intensively as they use the orchard habitat. There is considerable movement between the orchard and brush habitats as long as there is no barrier to prevent it.

The relatively open and unprotected edge habitat appears to be used in a limited way by the voles, primarily as a corridor through which to move between the brush and orchard. The large number of

trap captures, but the small number of telemetry positions, in this zone can be explained at least in part by rapid movements between the brush and orchard habitats.

Several animals moved into the brush toward the evening hours with only intermittent periods spent there during the day. This suggests that the animals preferred the shelter of the brush, but preferred to feed in the orchard. This conclusion is supported by the paucity of herbaceous vegetation on which to feed in the brush habitat.

Reducing the likelihood of reinvasion of the orchards by voles is an important element of a management program. By reducing or eliminating the movement of animals between the orchard and border habitats, a grower can create two separate populations, thereby allowing the implementation of a management program without the threat of invasion by voles from external sources. Although the bulldozed border strip appeared to be effective in stopping crossing movements, it is doubtful that a 20 m wide strip would be a practical control measure. Adjoining property lines often make it difficult to use many effective means of control.

Cole (1978) indicated that a clean, mowed strip 10 m wide was an adequate barrier to prairie vole movements. Another study in Australia (Barnett, et al., 1978) showed that small mammals rarely crossed open areas such as roads even if the road had long been unused and was partly overgrown. They also indicated that the number of crossings was inversely related to road width. Horsfal (1964) stated that roads and streams appear to act as barriers to meadow and pine vole movements along orchard borders. Other deterrents could include tilled and/or herbicided strips along orchard boundaries.

Where possible, border areas should be kept clean (Hamilton, 1935), since brush piles or overgrown corners can support a population of meadow voles. However, any alteration of the habitat should be done in conjunction with an orchard management plan since the removal of shelter could force animals to seek refuge in the nearby orchards (Horsfal, 1964).

The results of this study indicate that a sound vole management program should include habitats adjacent to the orchards. Although the location of the study site dictated the use of only meadow voles in this project, it is possible that many of the woodlots that exist near the orchards could harbor pine vole populations as well (Goertz, 1971; Paul, 1970; Benton, 1955). Further work needs to be done to identify the bordering habitats that could harbor meadow and/or pine vole populations. The effect of different population densities on movements across barriers, as well as the long-term effectiveness of barriers, must also be studied before final conclusions can be drawn.

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