MOVEMENTS OF THE PINE VOLE (*MICROTUS PINETORUM*) IN REPOPULATING ORCHARD HABITAT

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INTRODUCTION

Pine vole *(Microtus pinetorum)* populations cause significant damage to orchards and truck crops (e.g., Anthony and Fisher 1977, Biser 1967, Eadie 1954, Forbes 1972a). Yet their population structure and movement dynamics have received surprisingly little study (Smolen 1981). The scarcity of data may have been due in part to the former availability of Endrin as a highly effective control agent (e.g., Horsfall 1956b), but the appearance of Endrin-resistant populations (Webb and Horsfall 1967), the restrictions of use of chlorinated hydrocarbons, and the inclusion of pine voles in Integrated Pest Management programs have made the need for basic population data including immigration and emigration more acute. For example, demographic and movement information are universal components of IPM programs, because management of populations is usually, and appropriately, based on demographic expectations, such as: how rapidly can pine vole populations increase? What densities can they achieve? How quickly do they recolonize depopulated areas? These are fundamental questions that require well-controlled field studies with specific aims. Other studies that bear upon the relationship of demographics and movement provide important background but fail, because of either design or analysis, to directly answer the above questions. See for example: Gentry (1968), VanVleck (1968), Gettle (1975), Gourley (1983), Renzullo (1983), Fitzgerald and Madison (1983).

Of particular concern in this study is how quickly an area will become repopulated by nearby resident voles after control procedures have been used. Repopulation of one of these areas can become significant to the grower who has a young orchard planted adjacent to an older orchard that is infested with the pine voles. Likewise, there is concern by the grower who controls pine voles in his own orchard but has a neighboring fruit grower who does not. Perhaps most important is the need to know the details of reinvasion in order to assess more accurately the combined effects of reinvasion and demographic characteristics that result in concomitant pest population growth. For these reasons, this study was designed to learn more about reinvasion, particularly movements from the surrounding orchard, into an area where the resident population had been removed. Because of the inseparable connection between reinvasion and population growth potential, this investigation considered several related subjects including:

1. Movements of individual voles dispersing into an unfilled habitat.

2. Sex and age classes of dispersers.

3. Rate and pattern of reinvasion.

4. Differences between movements into the unfilled habitat and movements within an unmanipulated population.

METHODS

The study area was an 8-acre orchard block within a larger orchard which supported a large and persistent pine vole population (Fig. 1). This surrounding orchard habitat provided the source of animals moving into this suitable but empty habitat. Following extensive population reduction by a variety of rodenticides the remaining population in the 8 acres was removed by intensive trapping with both snap traps and live traps during early March. Following population decimation by rodenticides and trapping, vole activity in the study area was monitored for 8 months by use of the apple index technique (Horsfall 1956) and by live-trapping at 3-week intervals. Vole activity at each tree was determined in this manner by whether or not an apple slice had been chewed during the 24 hours after being placed in a runway.

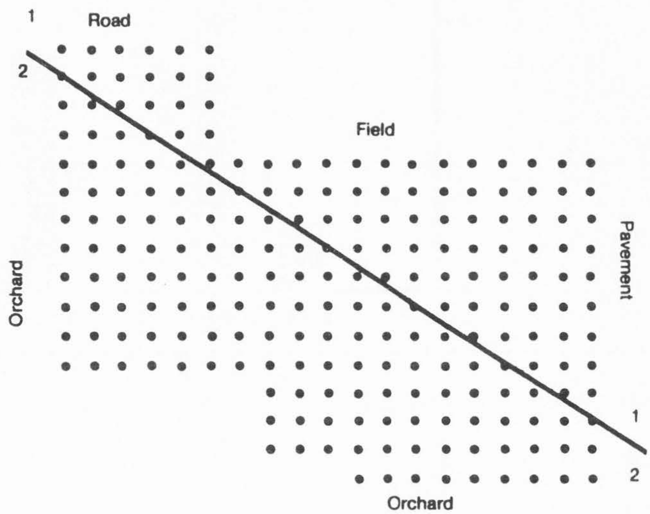

Figure 1. Diagram of the experimental orchard showing adjacent habitat and the two designated zones of reinvasion.

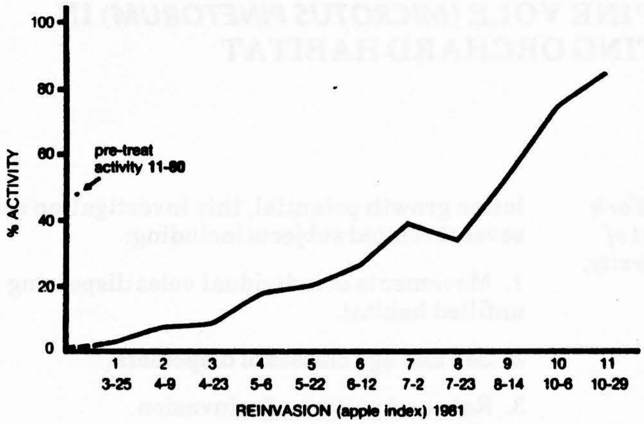

Figure 2. Apple activity index following removal of pine vole population in late fall of 1980. Ulster Co., N.Y.

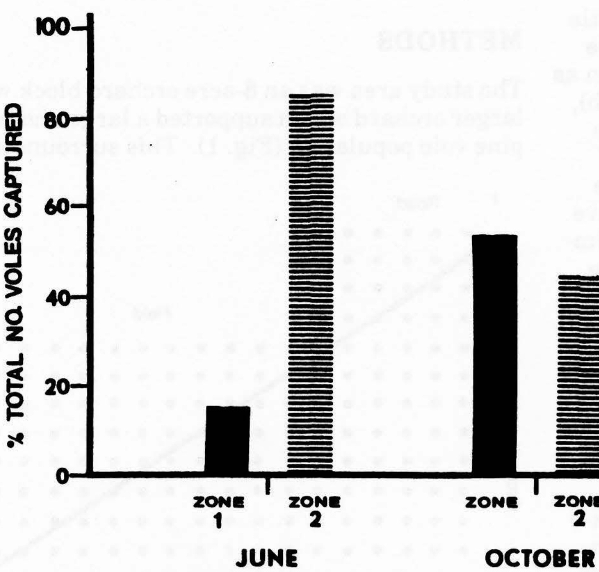

Figure 3. Distribution of pine voles captured at four months (June) and eight months (October) after reinvasion began.

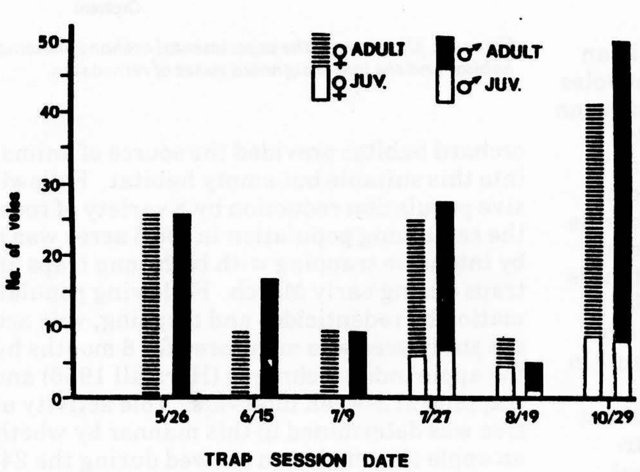

Figure 4. Sex and age classes of pine voles captured post-removal.

From May through October, 48-hour live-trapping sessions immediately followed each apple index procedure. One Sherman live trap was placed at each of 213 trees within the study area. All captured animals were marked and released after recording location, sex, age (based upon size and pelage) and reproductive condition.

Data on vole movements within the recently depopulated area were compared with data collected in a long-term field study of vole density, survivorship and reproduction during these same months from a previous year. The latter unmanipulated population served as a control.

RESULTS AND DISCUSSION

Repopulation of the depopulated area began immediately. The apple index method indicated a gradual but steady increase in vole activity from 3.0% in March to 83.7% in October (Fig. 2). The last areas to become repopulated were those most distant from the main orchard. Reinvasion and repopulation was so extensive that the number of trees showing vole activity was greater 1 year after the treatments and subsequent trap out than prior to any disturbance of this orchard.

In order to examine the general pattern of movement 2 zones were designated (Fig. 1). Zone 2, with orchard habitat on 2 sides, was closest to the source of invading voles. The more remote zone 1 was bordered by non-orchard habitat. In June, approximately 2 months after reinvasion began, 85% of all voles captured were found in zone 2, adjacent to a nearby orchard. By October, zones 1 and 2 were nearly equal at 54% and 45% (Fig. 3).

There was no significant difference between male and female captures throughout the reinvasion period (Fig. 4). VanVleck (1968), working with field populations of *Microtus pennsylvanicus*, reported no significant difference between the numbers of each sex caught by snap-traps, but found more females captured when live traps were used.

No juveniles were captured within the removal site before the fourth trap session in late July. Unlike the removal area, juveniles were found for each of these 3 sessions in the control population and made up a large part of the catch throughout the summer and fall period (Fig. 5). The ratio of juveniles to adults in the control population eventually reached a 1:1 relationship by fall whereas the juvenile to adult ratio in the depopulated area never achieved greater than a 1:5 ratio. The absence of young animals in the area being repopulated suggests that repopulation was due in large part to reinvasion by adult voles and that reproductive efforts were limited and/or survival of young reduced. Differential survivorship of young between the experimental and control plots could not be determined; however, the number of pregnant and/or lactating females was relatively higher in the control plot throughout the study, indicating a more sustained reproductive effort in the undisturbed population.

In undisturbed orchard situations pine voles are relatively sessile rodents, moving only 1 or 2 trees from the original site of capture or radio-location (Benton 1955, Paul 1970, Renzullo 1983, Fitzgerald and Madison 1983). Numerous individuals have been captured multiple times beneath the same tree over a 16-month period (Stehn and Richmond, unpublished data). Some dispersal of individuals undoubtedly occurs but there are few data to support this except in studies where movements have been induced by habitat disturbance, depopulation of an area, or experimental crowding. The general pattern of movement when it does occur in orchard habitat is for the animal to traverse the rows of apple trees always moving parallel with driveways found between rows. Seldom do voles cross from one row to another (Renzullo 1983, Gettle 1975, Horsfall 1964). Because of this pattern in an undisturbed population we first compared frequency of row crossing between the control and the site being reinvaded. The results showed significantly more row crossings per recaptured vole in the reinvasion plot than in the control suggesting that invading voles are only slightly impeded by the hardpacked driveways. Of those individuals known to cross rows in the experimental plot, Figure 6 shows no statistical difference in movements between sexes. Moreover, there was no difference between male and female movements along rows within the removal plot (Fig. 7), or along rows in the control orchard.

In comparing the experimental plot with the control there was a significantly ($X^2 = 7.85$, df = 1, $P < 0.01$) higher number of voles moving 1 or more trees away from their initial point of capture (Fig. 8). Also of interest here is the observation that even though movement was greater in the depopulated plot, nearly half of the voles captured in this plot did not move away from the tree where first caught. This suggests that many reinvading voles remain at the first acceptable/open site that they encounter. Because nearly all of the trees previously had voles, the subsurface

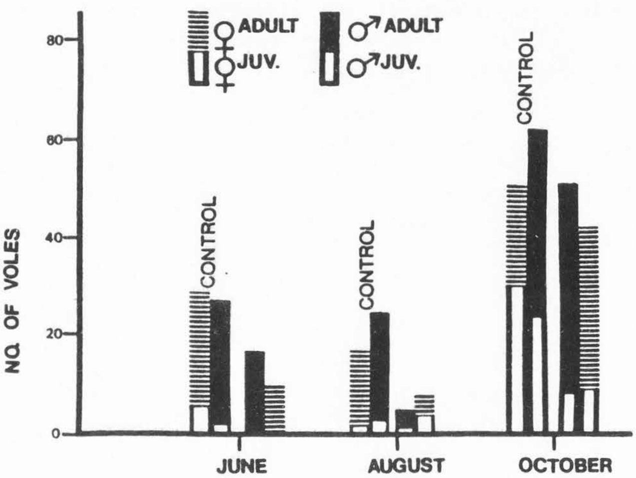

Figure 5. Sex and age classes of pine voles captured in the control and experimental orchard.

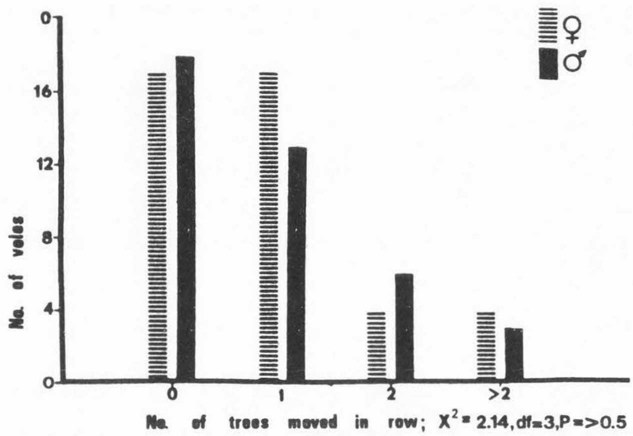

Figure 7. Numver of pine voles moving zero, one, two, or more than two trees from their initial capture site during reinvasion.

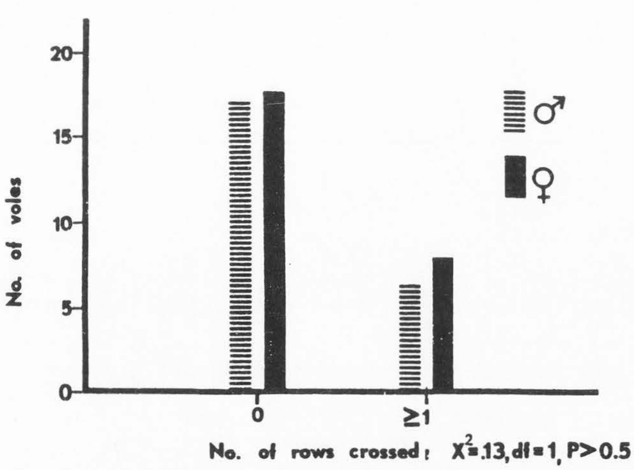

Figure 6. Number of pine voles crossing either zero or one or more rows during reinvasion of an orchard.

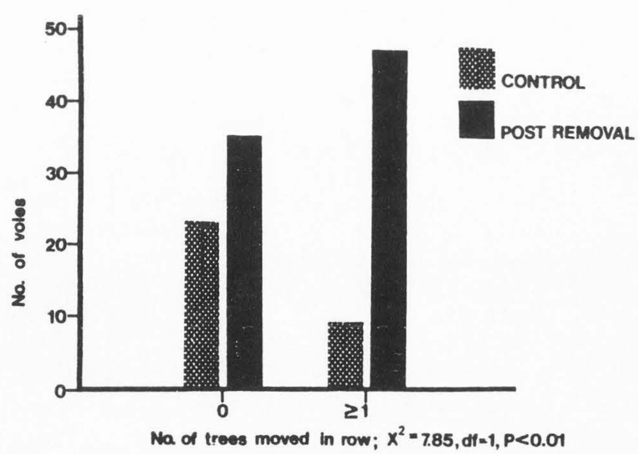

Figure 8. Number of pine voles (both sexes) and distance moved in a depopulated versus control orchard.

tunnels and possibly nests were already present at these sites.

Our expectation that females might show less movement than males was not borne out in the analysis of sex differences. Both males and females moved further along rows than their controls but the number of each sex moving 1 or more trees and the numbers not moving at all after first capture in the experimental plot were essentially the same. Seventeen of 40 males (43%) and 18 of 43 females (42%) were not captured beyond the tree of their initial capture.

SUMMARY

In summary, results of this field study of pine voles in a control (live trapped) and a depopulated orchard also live trapped indicate the following patterns of vole movements.

1. Very little pine vole movement occurs in undisturbed orchard habitat. Our findings presented here from the control orchard reinforce observations made by a number of other investigators working in different parts of the country and using different techniques.

2. In orchard habitat, voles rarely cross the drive path between rows. This partial barrier to movement is of little consequence when voles are reinvading an orchard following removal of the previous population. We were unable to detect a more rapid reinvasion along rows than across rows in this study.

3. Repopulation of an 8-acre plot began in March following elimination of voles the previous Fall. There was little movement into the plot during the winter period but after March the population doubled at approximately 6-week intervals until October. The last areas to become invaded were furthest from the source of invading voles.

4. Equal numbers of males and females comprised the invading population. All of the early invaders were judged to be adults based on pelage and size. Young voles appeared in the reinvasion plot late in the year whereas they made up a sizeable portion of the control catch during all months.

ACKNOWLEDGMENTS

The authors thank Anthony Moriello and Steve Coy for access to their property. We appreciate the typing and revisions of Charlotte Westbrook and Nancy Bowers and we thank Dan Decker for his review and comments. This paper is a contribution of the New York Cooperative Wildlife Research Unit, Department of Natural Resources, College of Agriculture and Life Sciences, Cornell University.

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