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Progress in Pine Vole Ecological Research  
and Its Relevance to Damage Control

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LaVoie and Tietjen (1971) pointed to the "paucity of quantitative data concerning vital phases of the life history of the pine vole" as one possible reason for our lack of progress in controlling pine vole damage. They suggested that pine voles do not seem to be readily adaptable to a wide range of habitat types and conditions and that this lack of adaptive ability might be exploited in their control by manipulation of limiting factors in their habitat. They also suggested a balanced program of research which would include studies of vole populations, their habits and their habitats as well as damage patterns and control methodology. We agreed with their assessment of the problem and have been collecting information on the first 3 factors named, i.e. pine vole populations, habits and habitats and their interactions.

Initially, we proposed to determine differences between the characteristics of pine voles in well managed apple orchards and those in a natural habitat, i.e., a hardwood forest. However, because we were unable to locate a population of voles in a natural habitat, we chose to use voles in an abandoned orchard for comparison. Paul (1970) had earlier reported that vole populations decline when an orchard is abandoned. Over the past 5 years, we have conducted two separate studies comparing characteristics of pine voles in maintained and abandoned apple orchards. In 1972 and 1973 we studied two orchards near Sperryville, Va. (Cengel et al. 1977; Estep et al. 1977) in 1974 and 1975 we compared two orchards near Daleville, Va. (Noffsinger 1976). Because of the large amount of data collected on voles and vegetation in these two studies, only a summary of the major findings will be presented here. The reader is referred to the cited papers for detailed procedures and data.

#### Findings of Studies Conducted

In general, the ground vegetation of the abandoned orchards was dominated by forbs and small woody plants, whereas that of the maintained orchards was dominated by grasses. The food habits of voles from the two orchard types reflected these differences (Cengel et al. 1977). Sixty to 95 percent of identifiable plant epidermal fragments found in the stomachs of voles from the abandoned orchard throughout the year were forbs. In contrast, 60 to 87 percent in the maintained orchard were grasses except in the May-July period when only 14 to 20 percent were grasses and 78 to 84 percent were forbs. This indicated to us that pine voles prefer grasses to forbs except in late spring and early summer when forbs are succulent and highly digestible.

Grasses identified in vole stomachs included fescue (*Festuca* spp), orchard grass (*Dactylis glomerata*), nimblewill (*Muhlenbergia schreberi*), and bluegrass (*Poa pratensis*). Forbs identified in stomachs included common ragweed (*Ambrosia artemisiifolia*), wild garlic (*Allium vineale*), spring cleavers (*Galium aparine*), plaintain (*Plantago* spp.), Japanese

honeysuckle (*Lonicera japonica*) and red clover (*Trifolium pratense*).

Some root fragments were found in vole stomachs from both orchards throughout most of the year but substantial amounts (7 to 14 percent of the identifiable epidermal material) were found only in the January-March period. Apple tree root fragments also were found only in the January-March period. Apple tree root fragments comprised a high of 3.2 percent of the identifiable plant epidermal material found in voles from the maintained orchard in March.

Epidermal tissue of apple fruit was found from September through May in the maintained orchard but only in January in the abandoned orchard. Since epidermal tissue comprises such a small part of an apple fruit, it is likely that apples were eaten over a much wider period than indicated, however.

Data on reproduction and body fat content were collected in both studies (Estep et al. 1977; Noffsinger 1976). A greater percentage of females was pregnant and a greater percentage of immatures was found in the maintained orchards in both studies. Weights of male and females reproductive organs were also generally greater in the maintained orchards. While body fat levels were not consistently different between orchards in the two studies, a marked decline in body fat stores occurred in the autumn months in voles from the abandoned orchards in both studies, indicating a declining nutritional plane at that time. This reduction in body fat either did not occur or was much less pronounced in the maintained orchards.

The dry weights and percent digestible energy of the stomach contents of voles were determined in the second study only (Noffsinger 1976). Both were markedly lower in voles from the abandoned orchard throughout most of the year, but the differences between orchards was especially great in early autumn.

#### Relevance of These Data to Damage Control

From the data obtained in these two studies we tentatively concluded the following:

1. Pine voles feed primarily upon above ground parts of grasses and forbs and turn to roots only when other foods are scarce.
2. Pine voles prefer grasses to forbs except in spring and early summer when forbs are in early growth stages.
3. Pine voles feed heavily on roots (including apple tree roots) primarily in late winter and early spring.
4. Winter population densities of pine voles are probably dependent on how late into the fall reproduction continues.
5. The extent of reproduction into the fall and winter months probably depends on the quality and quantity of readily available food in late summer and early fall.

6. The quality and quantity of preferred pine vole foods is greater in maintained orchards than in abandoned orchards (especially in late summer and early autumn) due to differences in (a) fertilization rates (b) relative crown closure of the trees (c) ground cover composition (d) mowing and (e) numbers of windfall apples.

If the interpretation of our data is correct, alteration of the food supply in a productive orchard by manipulating one or more of the above factors could substantially reduce vole populations by reducing reproductive rates. In particular we feel that maintenance of a grass ground cover and continual mowing of grasses along with numerous windfall apples usually found in maintained orchards result in a continuous highly nutritious food supply for voles which is conducive to high reproduction. Cultural practices which reduce available digestible energy supplies to voles during summer and autumn months and increase them during late winter (the time of greatest damage to tree root systems) should be sought. Cultivation techniques such as those reported by Byers et al. (1976) may be useful in attaining the above objectives. However, an alternative approach would be to alter the orchard floor composition to allow food sources to grow beyond the reach of voles. Perhaps fewer mowings/year or a drastic change in plant species present in orchards should be investigated as means of reducing food supply, reproduction and pine vole populations.

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