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SELECTED HABITAT CHARACTERISTICS AND PINE VOLE ABUNDANCE IN PENNSYLVANIA APPLE ORCHARDS

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In the past, researchers from The Pennsylvania State University have investigated specific aspects of the pine vole (Microtus pinetorum) and its biology (Fisher 1976, Gettle 1975, Simpson 1978). In our current research, we are investigating many factors of the pine vole's orchard habitat and examining these factors collectively. Our objectives are:

1) To determine what combinations of habitat characteristics relate best to abundance of pine voles in Pennsylvania apple orchards.
2) To recommend strategies on how to consider or modify those habitat characteristics to maintain the lowest possible numbers of pine voles.

From early June 1981 to early September 1981, we randomly chose orchards from aerial photographs of Adams County, Pennsylvania. Selected points were scattered all over the apple-producing areas of the county. Random points were located on the ground, and subsequently, 130 apple orchards were sampled. With the cooperation of the growers and landowners, we laid out a 50-x 50-m sample-plot at each random point. We used the tree corresponding to the original random point as a corner. We then measured characteristics of pine vole habitat within the driplines of the trees closest to each of the three remaining corners and within the plot. The habitat characteristics we measured were thatch depth, trunk diameter, and crown diameter. We also measured percentage of ground area covered by vegetation, using a vegetation sampling frame (Daubenmire 1968), and vertical cover of ground vegetation at several heights, using a vegetation profile board (Nudds 1977).

We took 6 soil samples per plot at 2 depth-intervals. The first sample was from the surface to 24 cm deep, and was taken with a soil probe, the other sample was from 28 to 48 cm deep, and was taken with a soil auger. After collecting over 700 samples, we ground each sample and used a 2-mm sieve to separate fines from gravel. To analyze the soils, we used a hydrometer for the fines to determine percentages-by-weight of sand, silt, and clay (Black 1965). Sieves were used to determine percentages-by-weight of various size-classes of gravel. We also measured the volumes of the soil samples taken with the soil probe, and we will use these volumes and the weights of the samples to calculate bulk density. The soil samples we collected represent all of the

soil associations found in the apple-producing areas of Adams County. These associations consist of silt loams, channery silt loams, gravelly silt loams, and very stoney silt loams.

Other habitat characteristics that we measured include: distance between trees within and between tree rows; slope and aspect of the sample-plot; and distance from the plot to a change in land-use such as residential, woods, pasture, crop, or old field. These land-uses were recorded, as well as any potential barriers to pine vole movement, such as paved roads, and streams and ponds.

After measuring habitat characteristics, we visited every tree in the plot and looked within the dripline for an entrance to a subsurface pine vole tunnel. If a tunnel was present, we placed a 30-x 30-cm piece of roofing felt over the entrance. If no tunnel was present, we placed the roofing felt somewhere on the ground within the dripline.

From the middle of September 1981 to the middle of October 1981, we visited each sample-plot 2 more times. On the first return we placed a piece of Golden Delicious apple, as bait, under each piece of roofing felt. If a pine vole tunnel was present, we placed the bait 5-15 cm into the tunnel. We then returned 20-24 hours later to check each piece of bait for toothmarks of pine voles. If toothmarks were present, we recorded that tree as active; we are using activity as an index of pine vole abundance. In addition to activity, we recorded presence or absence of a tunnel. The number of visits to trees, which included laying the roofing felt, placing the bait, and checking the bait, totaled over 18,000.

We have recently completed our soil analysis, which was the final stage of data collection. After some preliminary analysis, we see that we are on our way to meeting our objectives: in our investigation of apple orchards, we have sampled the full range of conditions of the habitat characteristics that we selected. We found very young to very old blocks; sparse to dense plantings; flat to steep terrain; and sparse to dense ground vegetation. Of the area sampled within driplines, five classes of ground vegetation were present (Fig. 1); these data represent samples over all orchards. Eighteen percent of the area was bare; 12% was covered by forbs such as nettle (Urtica spp.), clover (Trifolium spp.), yarrow (Achillea spp.), plantain (Plantago spp.), and sorrel (Rumex spp.); 13% was covered by grasses and sedges; 3% was covered by other material such as mosses, rocks, branches, bottles, prophylactics, and auto parts; 45% was covered by thatch, defined here as material that is dead, but recognizable as vegetative organic matter; and 9% of the area was covered by woody vegetation such as poison ivy, (Toxicodendron radicans), raspberry (Rubus spp.), virginia creeper (Parthenocissus quinquefolia), tree-seedlings, and root-suckers.

We measured spacing of apple trees as the number of trees in our 50-m tree rows (Fig. 2), and as the number of

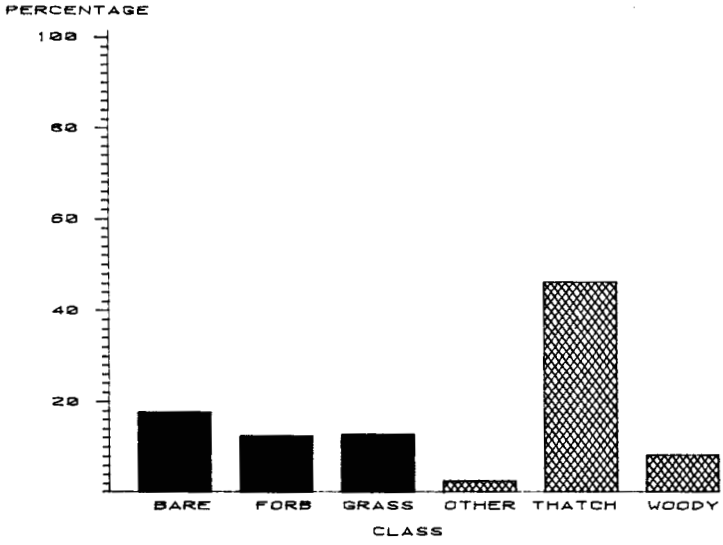

Fig. 1. Ground cover within dripline of apple trees.

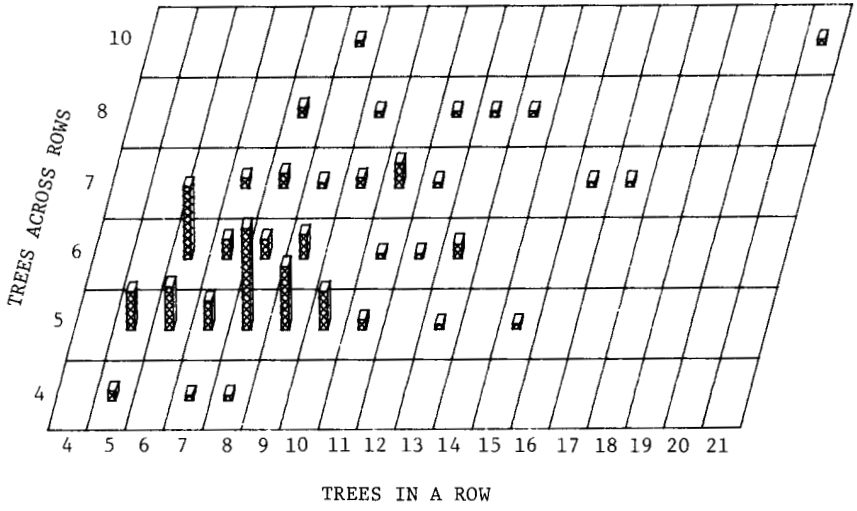

Fig. 2. Relative frequency of apple tree spacings in 130, 50-x 50-m, sample-plots.

trees in the 50-m length across the rows. Over 50% of the sample-plots had from 6 to 9 trees per row, and from 5 to 6 trees across rows. The most common spacing combination was 8 trees per row by 5 trees across rows, or a tree density of 40 trees/0.25 ha. The range of tree densities that we sampled was from 20 trees/0.25 ha to 210 trees/0.25 ha.

We found a large range of pine vole activity, defined here as the percentage of trees in a sample-plot which had bait at least partially eaten by pine voles. We found that 86 out of the 130 plots had activity, and the remaining 44 plots had no activity (Fig. 3).

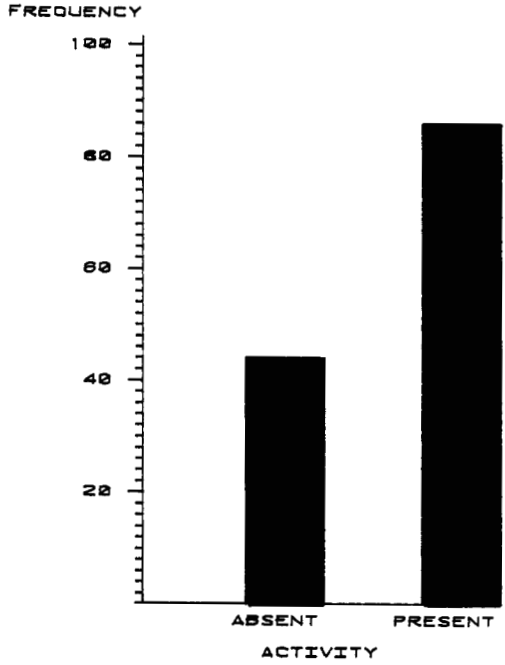

Fig. 3. Frequency of sample-plots with and without pine vole activity.

Of the 86 active plots, over half had between 1% and 10% activity. Specifically, 35 plots had between 1% and 5% activity, and 20 plots had between 6% and 10% activity (Fig. 4).

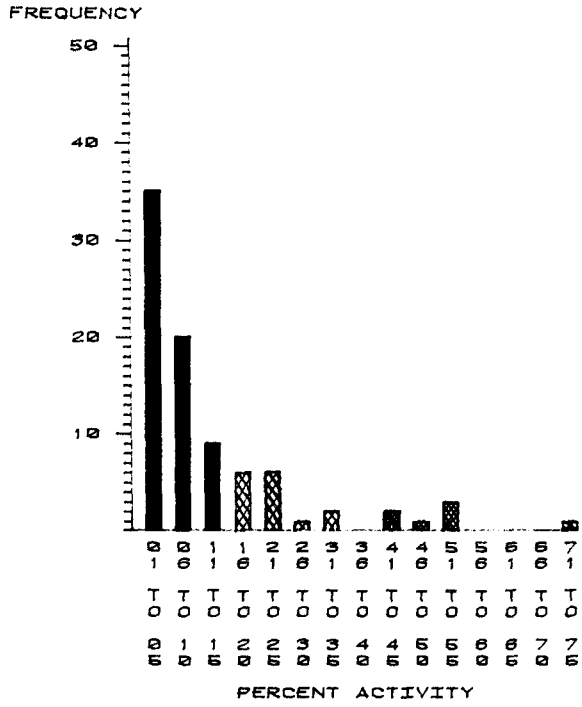

Fig. 4. Frequency of levels of pine vole activity in 130 sample-plots.

These preliminary results indicate that we are progressing toward our objectives. To meet those objectives, we will relate the range of conditions of selected habitat characteristics to the range of sampled abundance of pine voles. We will define combinations of orchard conditions that apple-growers can measure and manage and can incorporate into their plans for integrated crop management.

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