An Ecological Framework for Vole Management

Jay McAninch
New York Botanical Garden, Millbrook, New York

AN ECOLOGICAL FRAMEWORK FOR VOLE MANAGEMENT

Jay McAninch
Wildlife Biologist
The Cary Arboretum of The
New York Botanical Garden
Millbrook, New York 12545

A great deal of past pine vole (Microtus pinetorum) and meadow vole (Microtus pennsylvanicus) research has focused upon toxicants as a means of population control. The advent of more and more environmental restrictions on chemical uses and toxicant resistance in target populations has created endless research in this area of vole control techniques. The application of wildlife management principles through biological and cultural techniques could serve as a sound foundation upon which to build a vole control program.

Many growers and research personnel have noticed lower damage levels when even a few vegetative or environmental components of the orchard habitat have been altered. Horsfall, in several papers, advocated the cultivation of various forbs as primary food sources for voles (Horsfall, 1972a; Horsfall, 1972b; Horsfall et. al, 1974). This cultural technique provided an alternative food source for potentially damaging voles that consume apple bark and roots. Perhaps the greatest gain in maintaining forbs was the ingestion of ground sprayed toxicants by higher numbers of damaging voles. While forbs may deter voles from feeding on trees, they also maintain a favorable habitat for continuous vole populations and hence create an ever-present damage potential.

The work of Byers and Young (1974) with the Smitty tree hoe has been an advancement in the concept of destruction of vole habitat. The tree hoe has been successful in lowering vole population levels by the disruption of burrowing systems vital to the animal's existence.

At this symposium last year several speakers felt cultural management, encouragement of predators, and various other natural strategies held promise as more long-term control solutions. Young felt great possibilities for good control resulted from herbicide bands along tree rows. Alternatively Conley and Killian felt the elimination of current weed control practices would lower damage levels. Techniques to change the plant species composition on the orchard floor to reduce available digestible energy supplies in summer and autumn and increase supplies during winter were suggested by Kirkpatrick and Noffsinger. Anthony found soil texture regulated the distribution of pine voles in Pennsylvania orchards. Even with the efforts of these studies there still remains a multitude of environmental factors that have not been examined.

An ecological yet practical approach to the management of any wildlife species is to assay its population size or density per unit area then attempt to quantify the multitude of factors vital to the existence of the species in question. If management means control, as in the case of damaging voles, then techniques to create undesirable or marginal habitats would be essential. Once known, the variety of factors most correlated with higher vole densities should be disrupted or altered while those factors correlated with low vole densities should be the primary elements in the development of cultural techniques.

A Case Study

The application of the concepts described above was undertaken at the Cary Arboretum during the summer of 1977. Seven 3-4 ha. open field habitats were chosen as simple systems to test the responses of voles to various cultural management practices. All but one field had been frequently mowed in past years and supported vegetation such as bluegrasses (Poa spp.), bromegrasses (Bromus spp.), timothy (Phleum pratense), clove (Trifolium spp.), and plantain (Plantago spp.).

Field 430 was chosen as a more natural small mammal habitat having been last disturbed in late 1975. Vegetation in this field consisted of some brome grasses, plantain, goldenrod (Solidago spp.), sheep sorrel (Rumex acetosella), cinquefoil (Potentilla spp.), and bedstraw (Galium mallugo).

Field 177 was mowed with a sicklebar mower in late autumn, 1976. Grass height was 50-60 cm and the site was left unaltered during 1977. Field 544 was treated identical to 177 but was mowed with a rotary brush-hog mower. Field 312 was sicklebar mowed in May, 1977 when grass height was 25-30 cm. Field 223 was also mowed in May but with the rotary mower. Field 225 was mowed with the rotary mower in early June and again in mid-July when grass height at each mowing was 30-40 cm. Field 870 was mowed and baled into hay in early June and again in mid-July. The mowing techniques were designed to provide variations in ground litter, and vegetation density.

In August a .81 ha. grid was established within each field and live-trapped for seven days. The following seven days, live and snap traps were used to remove animals from eight, 110 m assessment lines that emanated from the original grid center. Density estimates were developed using the Lincoln index, the regression techniques of Smith et al. (1971), and a modification of a Lincoln index regression using integration procedures (Swift and Steinhorst, 1976).

Quantitative measures of vegetation density and ground litter depth were taken at 68 stations within the .81 ha. grid and averaged for the entire grid. Ground litter depth was found using a centimeter ruler and vegetation density at 0-25 cm, 0-1 m, and 1-2 m strata was measured with density boards (MacArthur and MacArthur, 1961; Birch, 1977). Plant species data was not analyzed since a previous study found vegetation taxa was not strongly correlated with vole densities (McAninch and Harder, 1977).

Our results established ground litter depth as a key factor in meadow vole densities. (Table 1). A regression relationship over the seven sites found ground litter accounting for .92 of the variation in vole densities. (Fig. 1). Vegetation density at the three strata measured did not account for appreciable portions of the variation in vole densities. Our conclusions for management practices to control voles in this simple system were to use mowing techniques that left little or no ground litter. Although haying was used in this study, fields with numerous seedlings would make this technique impractical. We have considered using flail choppers which finely chop cuttings and a bumper mower which is comparable to our rotary mower but able to clear vegetation to the base of the seedling. In addition our program for next summer will determine the frequency and type of mowing needed to keep ground litter low without becoming inefficient from the standpoint of

Table 1. Data summary of vole densities and vegetation parameters collected during August, 1977.

Field	Vole Density (ha)	Ground Litter Depth (cm)	Vegetation Density (percent) 0-25 cm	0-1 m	1-2 m
177	112	4.34	.65	.65	0
544	85	3.51	.95	.68	.01
312	69	2.87	.35	.20	0
223	62	2.85	.57	.42	0
225	42	1.38	.43	.26	0
430	33	1.34	.48	.37	.06
870	10	1.30	.45	.34	0

man-hours involved.

Conclusions

Several conclusions from this study reinforce the basis for an ecological framework for vole management. The first is the underestimation of the effects of predation on vole populations. Field 430, the natural, less disrupted site, produced three short-tailed weasels (*Mustela erminea*) during our live-trapping period. Fitzgerald (1977) found short-tailed weasel diets were 98.1 percent voles. Even when vole densities were low, weasels continued to select voles in spite of increasing scarcity. Several of our study areas were bordered by stone rows and dead fallen timber that probably served as denning sites of

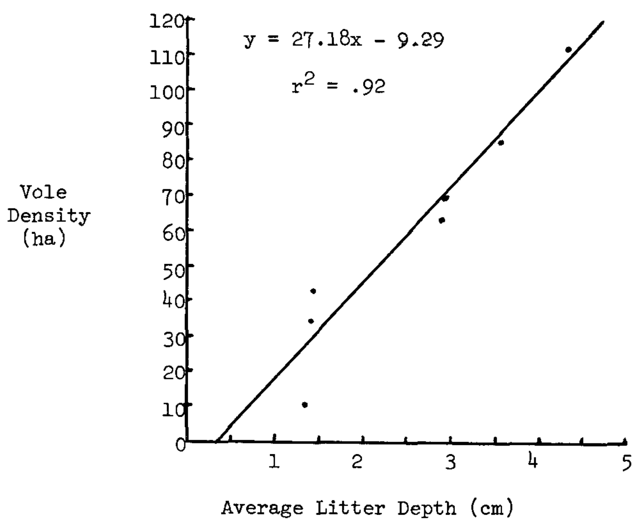

Fig. 1. Regression relation of vole density and average litter depth.

weasels. Vole consumption by resident weasels could be considerable as demonstrated by a captive female at our lab who consumed 1.2 voles per day during the summer months.

Reducing ground litter likely allows heavier predation pressure not only by weasels but also foxes, snakes, vagrant house cats, and avian predators such as kestrels and red-tailed hawks. Providing adequate denning, nesting, and perching sites likely would encourage predators to take up residence and become a natural component of a vole control program.

The second noticeable product of our cultural practices was the change in site factors. In fields where vole densities were low, soil compaction was greater probably due to less soil moisture, less ground cover, and the impact of mowing equipment. Minimal ground cover likely exposed voles to more extreme summer heat and winter cold. Reduction of ground litter also returned less humus to the soil which in combination with dryness and compaction would make burrowing more difficult. In essence, cultural practices can make life fairly difficult for meadow voles.

Due to the complexities of the orchard environment, the extrapolation of our results would mean many more factors have to be quantified and correlated to vole densities. These might include vegetation density, ground litter depth, soil moisture, soil density, soil texture, fertilizer rates, light intensity beneath the tree canopy, vegetation taxa, and many other parameters. Those factors highly correlated with low vole densities should become useful management tools while techniques to disrupt or alter factors correlated with high vole densities should be promoted. Development of the techniques to discourage voles would be tempered by the need for maximizing fruit production and limited by unchangeable factors tied to the physiography of the block. The degree to which additional controls such as toxicants are necessary would be dependent upon the relationship between vole densities and damage levels. Estimation techniques such as those described in this study or documented by Overton (1969), Eberhart (1969), and Jolly (1965), would provide reliable estimates of vole densities. Using these estimates as validation, research programs need to develop simple, rapid, and accurate techniques for evaluating vole densities each autumn. Once known, the success of control strategies could be established. When populations have reached the lowest levels possible under a conscientious cultural management system, the economic and ecological ramifications of toxicants as controls could be better evaluated and justified.

In New York's lower Hudson Valley region, growers were granted the use of Endrin in 1977 after a six year ban. Adverse publicity has been rampant in regional newspapers and among civic organizations. Few people understand that inadequate research monies and consequently research programs have not provided growers with sound, long-term control strategies. An increase in federal and state funds in conjunction with research programs oriented within an ecological framework for vole management should be the ultimate goal.

Literature Cited

Birch, W. L., Jr. 1977. Ecological separation of *Peromyscus maniculatus Bairdii* and *Peromyscus leucopus noveboracensis* (Rodentia) in southcentral Ohio. M.S. Thesis. Ohio St. Univ., Columbus. 86pp.

Byers, R. E. and R. S. Young. 1974. Cultural management of pine voles in apple orchards. Hort. Sci. 9(5):445-446.

Eberhardt, L. L. 1969. Population estimates from recapture frequencies. J. Wildl. Manage. 33(1):28-39.

Fitzgerald, B. M. 1977. Weasel predation on a cyclic population of the montane vole (<u>Microtus montanus</u>) in California. J. Anim. Ecol. 46:367-397.

Horsfall, F., Jr. 1972a. Chloraphacinone and herbage as potentials for pine mouse damage control. p. 32-46. <u>In</u> J. E. Forbs, Ed., Proc. N. Y. Pine Mouse Symp., Kingston, N. Y. 75pp.

________________. 1972b. The origin, history, and role of ground cover diversity. Va. Fruit, August. 5pp.

________________, R. E. Webb, and R. E. Byers. 1974. Dual role of forbs and rodenticides in the ground spray control of pine mice. Proc. Vert. Pest Control Conf. 6:112-126.

Jolly, G. M. 1965. Explicit estimates from capture-recapture data with both death and immigration-stochastic model. Biometrika 52(2):225-247.

MacArthur, R. H. and J. W. MacArthur. 1961. On bird species diversity. Ecol. 42:594-598.

McAninch, J. B. and J. D. Harder. 1977. Habitat utilization by the white-tailed deer and small mammal populations on the Cary Arboretum. Ohio St. Univ. Res. Foundation Proj. No. 4072., Columbus. 68pp.

Overton, W. S. 1969. Estimating the numbers of animals in wildlife populations. p. 403-455. <u>In</u> R. H. Giles, Jr., Ed., Wildlife Management Techniques, 3rd ed. The Wildl. Soc., Wash.,,D.C. 633pp.

Smith, M. H., R. Blessing, J. G. Chelton, J. B. Gentry, F. B. Golley, and J. T. McGinnis. 1971. Determining density for small mammal populations using a grid and assessment line. Acta Theriol. 16: 105-125.

Swift, D. M. and R. K. Steinhorst. 1976. A technique for estimating small mammal population densities using a grid and assessment lines. Acta Theriol. 21:471-480.