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Damage to apple tree roots by pine voles is believed to occur primarily during the winter months. Cengel et al. (1978) found that the stomachs of pine voles contained significant amounts of root material only during January and March sampling periods. In addition, the diet of pine voles at that time consisted primarily of less preferred grass species because preferred forb species were unavailable. Therefore, apple tree roots may serve as a food source in the winter when preferred forages are unavailable. If, in fact, pine voles are consuming roots in response to reduced food supplies, then one would expect the nutritional quality of the diets of pine voles to be its lowest during the winter. The objective of this study was to determine if there was a winter decline in the digestibility of the diet of the pine vole.

To achieve this objective, a technique was developed for predicting the digestible dry matter (DDM) and digestible energy (DE) of the diets of pine voles from a nutritive analysis of their stomach contents. This technique utilizes regression equations that were developed from data obtained from 24 digestion trials with pine voles. The diets in those digestion trials were made up of combinations of common orchard forages and commercial feeds. The diets and the stomach contents of pine voles on those diets were analyzed by the procedures of Goering and Van Soest (1970). This method of nutritional analysis divides forage samples into a highly digestible fraction, cell solubles, and a variably digested total fiber fraction. The various components of the fiber fraction are then determined in subsequent steps. These fractions were used as variables in stepwise regression procedures to develop equations for predicting the DDM and DE of the diets of pine voles from an analysis of their stomach contents.

It was found that the cell soluble content of the stomach contents provided the best prediction of both DDM and DE. However, preliminary studies revealed that pine voles apparently ingested a substantial amount of soil in the wild. This necessitated correcting the cell soluble content of the stomach contents for the amount of acid insoluble ash (AIA) that they contained.

To apply this technique for determining diet digestibility in the field, voles were snap-trapped bimonthly from late summer to early spring in two orchards. Voles also were trapped in two additional or-

chards during December. The stomach contents of these animals were removed, weighed and analyzed for levels of cell solubles and AIA. Diet digestibility was then estimated from the AIA-corrected cell soluble levels of the stomach contents.

The amount of dry matter in the stomach contents was not significantly different between months in the orchards trapped bimonthly, nor were there any apparent trends. Significant differences also did not exist between the four orchards sampled in December. The DDM and DE in the diets of pine voles were not significantly different between months or between orchards. The DDM and DE of the pine vole's diet in one orchard did decline steadily from a high in August to a low in December, then rose just slightly in February and remained the same in April. The DDM and DE of the diets of voles in the second orchard decreased gradually, but only slightly from October to April.

From these data, it appears that the digestibility of foods consumed by pine voles does not decrease substantially during the winter as previously hypothesized. Nutritional deficiencies may still occur in the winter, however, probably due to a decrease in the availability of forages. Three studies at VPI and SU have shown that the fat levels of pine voles decrease during the late winter months which indicates that voles are experiencing a nutritional deficiency (Cengel and Estep 1978, Noffsinger 1976, Lochmiller, unpublished data). The dry weight of the stomach contents examined in the present study did not indicate food shortages existed in the winter. However, the weight of the stomach contents is probably not an adequate indication of food shortage by itself. Therefore, we can conclude that the digestibility of the diet of pine voles does not decrease substantially in the winter and that nutritional deficiencies that occur in the winter may be primarily a result of a decreased availability of forages.

These data add to our overall understanding of root damage by pine voles. At this symposium last year, we reported that root bark was approximately 50% digestible during all seasons of the year (Servello et al. 1981). This is about 15% less digestible than the normal diets of pine voles in maintained orchards. Therefore, it is doubtful that pine voles would prefer root bark to their usual diet of grasses and forbs because of the large difference in digestibility. However, if root bark made up 15% [the maximum found in field studies (Cengel et al. 1978)] of the diets of the pine voles when the digestibility of other forages was at or near 70%, then total diet digestibility would drop only 3%. This level of root consumption probably could be tolerated easily.

At this symposium last year, we also proposed the hypothesis that pine voles may increase their consumption of root bark during the winter because of increases in its sugar content (Servello et al. 1981). Sugar levels in root bark reach their highest levels in midwinter and are almost double summer levels. The increase in sugar levels may make root bark more palatable to pine voles in the winter. This increase in root bark palatability coincides with the period of reduced forage availability described above. In addition to a decrease in food supplies and an increase in root palatability influencing root consumption, pine voles may simply spend more time in and around their nest in the winter which

would provide increased opportunity for gnawing behavior. These three factors probably act together to cause the increase in root bark consumption by pine voles.

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