

# Vertebrate Management

## **White-tailed Deer** (*Odocoileus virginianus*)

Deer are attracted to nearly all species of fruit trees. Deer are selective browsers or grazers and move slowly through the orchard feeding on leaves, twigs, and fruits from different trees or on ground covers. They may also browse heavily on one tree and ignore others close by. They are frequently seen browsing orchards in early summer, late summer, and fall when food is most scarce. The most common damage occurs when emerging leaves and shoots are eaten in spring and summer. In late summer to early winter, fruits and nuts make up a large part of their diet. Deer have no upper incisor teeth. They pinch their food with their lower incisors against a tough pad in their upper jaw and leave ragged edges at the point of detachment. This type of damage is most devastating in young plantings. During September to November (after antler growth is complete) bucks may damage trunks and scaffolds by rubbing their antlers to leave their sign. (They do not use the trunks to rub off the velvet on their antlers as is commonly believed; this falls off naturally.)

Deer are creatures of habit and will not return to a predominantly forest diet once more nutritious plants have been found. While damage from deer browsing is most severe on young trees, significant economic losses can also occur in mature orchards. Damage varies from slight to extreme depending on population, weather, alternate food sources, and tree size. Damage generally varies season to season and year to year.

Their home range tends to be quite limited – often as little as 1 square mile. Heavy hunting pressure, dogs, and seasonal changes in food supply can cause deer to shift their use areas within their home range. Bucks increase their movements slightly in the fall mating season.

## **Management**

Effective management begins by anticipating the extent of possible damage and then responding with appropriate control measures. Consider the severity of deer damage during the previous year and reports of deer density in your area as indicators of potential problems. Compare the cost of control versus the cost of damage. In new plantings, browsing damage may set back the development and subsequent fruiting of the orchard for several years. In extreme situations, damage may prevent an orchard from ever reaching its potential. Several methods for limiting deer damage might be considered. Each of them, or combinations of them, may prove to be effective:

**Habitat modification.** Deer prefer early successional forests that are in the shrub-tree sapling stage. They are abundant in agricultural areas where field crops and orchards are interspersed with forest habitat. Converting forest areas adjacent to orchards to cropland or pasture may help limit movement of deer into orchards.

**Hunting.** Encourage hunting on the farm. Nonhunted areas may serve as refuges during hunting season. Hunters should be encouraged to harvest doe deer to keep the population in check.

**Shooting.** Check with area wildlife officers regarding permission to shoot deer out of season if they become a problem. Lethal control methods are often temporary in nature.

**Repellents.** Repellents vary in their effectiveness. They are affected by population, feeding habits, and environmental conditions. They may be effective if damage is light to moderate, if small acreages are involved, and if few applications will be needed for adequate control. **Repellents will not work satisfactorily in high-pressure situations.**

Two different types of repellents are available. The first type is an area repellent, which includes things such as tankage (putrified meat scraps), ammonium soaps, bone tar oil, blood meal, human hair, and bar soap. These repellents should be applied close to or on the plants needing protection. In some cases, putting them on the side of the orchard from which the deer enter is effective. However, it may be necessary to disperse repellents throughout the planting. The other general type is a contact repellent that works by taste. Apply it directly to plants

during the dormant season and on dry days when temperatures are above freezing. Expect some feeding damage when taste repellents are used. Repellents in this category include putrescent egg solids, thiram, and hot pepper sauce. Reapplication is often necessary as rainfall will wash the repellents off. When using commercial repellents, always follow label directions. Below are commercial repellents used to repel deer in orchards.

Common Name	Product Name	EPA Reg. #
13.8% ammonium Soap <sup>1</sup>	Hinder	4-15
37% egg solids	Rockland Deer Guard	4866-10
20% thiram	Chew-Not	358-105
11% thiram, 11% acrylic Polymers	Bonide Rabbit-Deer Repellent	4-136
2.5% capsaicin	Hot Sauce Animal Repellent	72-574

<sup>1</sup>Application to apples under hot, humid conditions may result in fruit-finish problems such as spray burn rings.

Soap bars also have been used in orchards to repel deer. Drill a 1/4-inch hole through the center of each small soap bar. Leave the wrapper on to prevent excessive weathering. Hang the bars away from the trunk on a wire or string and about 30 inches above ground. Putting soap bars in nylon mesh bags tied onto trees instead of using wire or string may keep the soap on the trees for a longer period of time. Bar soap has no EPA registration. The cost of materials plus the substantial amount of labor involved in putting the soap bars on trees may render this treatment economically impractical.

**Fencing.** In areas having a high deer population, fencing may well be the only viable control method. Electric fences offer an effective, less expensive option than conventional fences.

A single strand of high-tensile wire 30 inches above ground can be quite effective if it is visible so the deer will investigate. Treat the wire with a 50/50 mixture of peanut butter and vegetable oil or drape aluminum foil strips coated with peanut butter to attract deer. Decorating the wire with flagging will further increase effectiveness. Highly visible fences with very conspicuous wire (wire impregnated tape) are visible to deer and are effective without an attractant. Once deer get shocked from the fence, they tend to avoid the area unless they are being chased.

In extreme pressure situations, the Pennsylvania five-wire fence might be justified. It is constructed with five high-tensile strength wires stretched to 250 pounds tension and charged using a high voltage/low impedance “New Zealand-type” energizer. Wires are charged so as to shock deer from wire to wire. Put the lowest wire 10 inches above ground and space the others 12 inches apart. Baiting the middle wire with peanut butter may increase the effectiveness of the fence. Control weeds along fences to avoid shorting them out. A 6 to 8-foot mowed strip around the fence should be maintained to discourage deer from jumping and to lessen the weed load on the fence. Fences need to be checked on a regular basis to be certain that the shocking power is sufficient to turn deer. Fencing will also keep bucks from damaging young tree trunks by rubbing their antlers against the trunks. To protect individual trees, set three fence posts 1 to 2 feet apart in an equilateral triangle around each tree. Unelectrified fences for deer exclusion need to be at least 8 feet high to be effective. They are much more costly than electric fences.

### **Cottontail Rabbit** (*Sylvilagus floridanus*)

Rabbits feed on a wide variety of green vegetation. During spring through fall, clover, grass, and broadleaf weeds are the mainstay of their diet when other green vegetation is not available. During winter they shift to twigs, buds, and bark of woody plants. This is when damage occurs to young fruit trees. Favorable habitats for rabbits include thickets, brush piles, fencerows, grassy fields, and perimeters of cultivated fields. Rabbit populations are directly related to the amount of favorable habitat and can become high if predation is light or lacking. Several methods for controlling rabbit damage exist. A combination of techniques will provide the most satisfactory results:

**Habitat modification.** Remove brushy, thick habitats in the vicinity of orchards.

**Exclusion.** Guards around young trees can prevent rabbits from feeding on the bark of the trunk. The best guard is probably a piece of 1/4-inch mesh hardware cloth. It should extend from 2 inches in the soil (for stability) up to 18 to 24 inches above ground. The guard should be big enough that when it is placed around the tree trunk it can be left for several years without the risk of it girdling the trunk of the tree. Solid guards that prevent good sunlight or spray contact with the trunk, restrict air circulation around the trunk, or fit closely around the trunk should be put on in late fall and removed in spring to prevent pests from building up under the guard or girdling the trunk. A 3-foot-high fence made of small-mesh chicken wire will keep rabbits out. Bury the lower part of the wire a few inches in the ground to prevent rabbits from going under it. Keep weeds and grasses from growing up along the fence.

**Repellents.** Certain taste repellents are effective in preventing most feeding damage by rabbits when sprayed on tree trunks at the appropriate times or when mixed in with white latex paint being applied to tree trunks for prevention of southwest trunk injury. These repellents include the following:

Common Name	Product Name	EPA Reg. #
13.8% ammonium soap <sup>1</sup>	Hinder	4-15
37% egg solids	Rockland Deer Guard	4866-10
20% thiram	Chew-Not	358-105
11% thiram, 11% acrylic Polymers	Bonide Rabbit-Deer Repellent	4-136
2.5% capsaicin	Hot Sauce Animal Repellent	72-574

<sup>1</sup>Application to apples under hot, humid conditions may result in fruit-finish problems such as spray burn rings.

## Voles

Pine vole (*Microtus pinetorum*)

Meadow vole (*Microtus pennsylvanicus*)

Prairie vole (*Microtus ochrogaster*)

Cotton vat (*Sigmodon hispidus*)

Voles are compact rodents with stocky bodies, short legs and short tails, small eyes, ears that are partially hidden, and dense underfur covered with thicker, longer guard hairs. Voles are usually brown or gray, but many color variations exist.

Southeastern orchardists need to be concerned with pine voles, meadow voles, and prairie voles. In addition to voles in orchards, the hispid cotton rat (*Sigmodon hispidus*) may also be found. Outlined below is the geographic area in which each of these animals may be found.

Pine vole <sup>1</sup>	Found from central Texas to Wisconsin and east to the Atlantic coast with a few exceptions such as southern Alabama and the southeastern corner of North Carolina.
Meadow vole <sup>1</sup>	North Carolina, South Carolina, north part of Georgia and Tennessee (northeastern part)
Prairie vole <sup>2</sup>	Arkansas, Missouri, Alabama (northern third of the state), Tennessee (all except extreme east Tennessee)
Cotton rat <sup>2</sup>	Alabama, Georgia, South Carolina, North Carolina (all except for northeastern corner), and Tennessee (all except for northern areas of middle Tennessee)

<sup>1</sup>Johnson, M.L. and S. Johnson. 1982. Voles. Pages 326-354 in *Wild Mammals of North America: Biology, Management and Economics*. J.A. Chapman and G.A. Feldhammer, eds. The John Hopkins University Press, Baltimore, MD.

<sup>2</sup>Schwartz, C. W., and E. R. Schwartz. 1981. *The Wild Mammals of Missouri*, rev. ed. Univ. of Missouri Press, Columbia. 356 pp.

Monitor to determine if voles or cotton rats exist in the orchard and what types of voles are present. Some differences exist between types of voles regarding control practices.

Pine voles, also called woodland voles, average 4 to 6 inches in length (including the tail, which is about the same length as the hind foot). Their brown fur is soft and dense. Some underparts are gray mixed with some yellow to cinnamon. The tail is barely bicolored or unicolored. They have small, indistinct eyes as compared to the meadow vole.

Meadow voles average 5 to 7 inches total length (including the tail, which is about twice the length of the hind foot). They have gray to yellow-brown fur obscured by black-tipped hairs. Their underparts are gray (sometimes washed with silver or buff). The tail is bicolored.

Prairie voles average 5 to 7 inches in length from the nose to the tip of the tail, which is about twice as long as the hind foot. Their fur is gray to dark-brown and mixed with gray, yellow, or hazel-tipped hairs giving it a peppery appearance. The underparts are gray to yellow-gray.

Cotton rats average 10 inches in length, including a 4-inch tail, which is scaly and sparsely haired. They have relatively large eyes and large ears that are almost hidden in blackish or grayish fur with rather stiff black guard hairs. They have four toes and a small thumb on the front feet and five toes on the hind feet.

### **Habitat**

Voles and cotton rats occupy a wide variety of habitats. They prefer areas having a heavy groundcover of grasses, grasslike plants, or litter. When two species are found together in an area, they usually occupy different habitats. Orchards, windbreaks, overgrown fencerows and ditch banks, and cultivated fields (especially no-till fields) are favorable habitats. In addition to these, the different types of voles have some other habitat preferences.

Pine voles may be found in deciduous and pine forests, abandoned fields, shrubby areas, orchards, and other areas having heavy groundcover. They are particularly prevalent where the soil texture permits easy tunneling.

Meadow voles prefer wet meadows and grassland habitats, particularly unmowed or infrequently mowed tall fescue fields.

Prairie voles may be found in old fields and marshlands. (When in association with cotton rats, they favor the drier areas.)

### **Population Development and Fluctuations**

Voles may breed throughout the year in a mild winter, but litters are most common in the spring and summer. They have one to five litters per year with an average of three to six young per litter. The gestation period is about 21 days, and voles become sexually active at the age of one month. Young are weaned by the time they are 21 days old. Females mature in 35 to 40 days. Their peak breeding period is between March and October, but in mild winters they may breed all year. A single female meadow vole could potentially produce more than 70 young in a year. The average lifespan of a vole is short, probably in the range of 2 to 16 months.

Large population fluctuations are common. Population levels generally peak every 4 years, but the cycles are not predictable. Dispersal, food quality and quantity, climate, predation, physiological stress, and genetics all affect population levels. Other factors are also probably involved.

Cotton rats are very prolific and will breed throughout the year. Several litters averaging 2 to 15 per litter may be produced annually. The gestation period for the female is 27 days, and the young are weaned in 10 to 15 days. Most females breed for the first time at 2 to 3 months of age. The average lifespan of a cotton rat is about 6 months.

## **Behavior**

Voles are active day and night throughout the year. Their home range is usually 1/4 acre or less but varies with season, population density, habitat, food supply, and other factors.

Voles construct many tunnels or surface runways (depending on the type of vole) with numerous burrow entrances. A single burrow system may contain several adults and young. Meadow voles and prairie voles build surface runways in grass and litter. Their runways are 1 to 2 inches wide. Vegetation near well-traveled runways may be clipped close to the ground. Feces and small pieces of vegetation will be found in the runways. Nests built of dry grasses and leaves are large, globular, and may be found close to tree trunks in clumps of grass.

Pine voles do not use surface runways. Instead, they construct an extensive system of subterranean tunnels in loose, crumbly soil. As they tunnel, they push out dirt producing small, conical piles of soil on the surface of the ground. Their nests are large and globular and are built of dry grasses and leaves. They may be found near tree trunks, clumps of grass, and at the end of tunnels.

Cotton rats are basically nocturnal but can be active during the day. They do not hibernate. Their home range is small and may range from 1/4 to 3/4 acre for females and from 1 to 1 1/4 acres for males. They can swim and are not hesitant to do so.

Cotton rats are most abundant in areas with thick, tall grass. The nest is a crude mass of dry grass fibers stripped from larger plant stems and placed in shallow surface depressions, among clumps of coarse grasses, underground in shallow tunnels, or under rocks or logs.

Evidence of cotton rats include the presence of stem and grass cuttings 2 to 3 inches long piled at various locations along 3- to 5-inch-wide runways. Pale greenish or yellow droppings about 3/8 inches long and 3/16 inches in diameter may be present along the runways.

## **Damage and Damage Identification**

Meadow voles, prairie voles, and cotton rats may cause extensive damage to orchards by feeding on and girdling the base of trunks or roots at or near the soil line. This damage is most apt to occur in late fall and winter when more preferred food sources of grasses, tubers, and seeds become limited. The presence of snow cover often encourages severe injury. Pine voles may cause damage beneath the surface of the soil, generally to a depth of about 6 inches. Frequently, injury to trees is not evident until trees are in decline, often past the point of salvation. Wounds created by voles and cotton rats may also serve as entry points for insects and/or diseases, which may further enhance tree decline and death.

Voles make nonuniform gnawing marks that occur at various angles and in irregular patches. These marks will be about 1/8 inch wide, 3/8 inch long, and 1/16 inch deep.

## **Damage Prevention and Control Methods**

Vole control is a year-round project. Many practices are directed toward discouraging the presence of voles in the orchard. In some years, these practices may need to be supplemented by the use of rodenticides.

Several different concepts may be used in preventing vole and cotton rat damage in orchards. These include nonchemical techniques involving certain cultural practices in the orchard, exclusion, and habitat modification. Rodenticides may be used for vole control. However, they are not labelled for cotton rat control in orchards at this time. A combination of several methods will provide the best protection.

## **Biological Controls**

Voles are prey for many predators including coyotes, snakes, owls, hawks, weasels, dogs, and cats. Predators do not normally control vole populations due to the tremendous reproductive capability of voles. Predation can be enhanced by not discouraging the presence of predators and by following some of the practices outlined below.

**Exclusion** involves the use of tree guards. As described in the section on rabbits, 1/4-inch mesh hardware cloth probably makes the most desirable tree guard. Guards should be installed at planting and be left in place for several years since the first 5 years of tree life is when most damage is apt to occur. Therefore, the guard should be large enough that it will not girdle the tree during this period. If other types of guards are used, they should be white to limit trunk heating during the winter months. Solid guards should not be used. Guards having few vent holes should be put on in the fall and removed in spring to prevent pest problems from developing on the tree trunk under the guard. Monitor spiral guards to be sure that shoots do not grow through vent holes, which can lock the guard so that it cannot expand as trunk diameter increases. Guards should extend from about 2 inches below ground (for stability and to exclude meadow voles, prairie voles, and cotton rats) to about 18 to 24 inches above ground. Guards are not effective deterrents for pine voles as they work primarily underground. The cost of purchasing and installing guards is substantial. However, compared to the potential loss from damage, they can be a good investment.

Certain **cultural practices and habitat modification** in and around the orchard can reduce vole presence. The major food source for voles is not apple trees, but roots and stems of grasses and other groundcover. Elimination of weeds, groundcover, and litter under and around trees will reduce the capacity of these areas to support voles and cotton rats, increase their exposure to predators, and lessen the availability of nesting materials. The use of herbicides to maintain clean areas extending at least 3 feet out from tree trunks plus close, frequent mowing of the orchard floor and the area around it will restrict vole movement into the orchard. Tillage, where possible, also removes cover, destroys existing runways and burrow systems, and kills a fair number of voles outright. Keep in mind, however, that tilling too deeply will cause root damage to trees. Tillage should be avoided in sites having a severe erosion potential. These practices are much more effective in controlling the surface feeding voles than pine voles.

Voies can live in dense populations in ditch banks, rights-of-way, unmowed waterways, and adjacent fields. Cleaning up and mowing these areas can discourage vole movement into orchards.

After harvest, remove or shred dropped fruit and leaves to speed up decomposition. Raking dropped fruit and leaves from under trees and into windrows between rows and then shredding this material removes a preferred food source as well as removing potential cover and destroying runways and shallow tunnels.

Pelleted formulations of baits are preferred to grain baits as they tend to weather better, are more effective against voles, and pose less of a threat to other wildlife than grain baits.

**Toxicants (rodenticides)** may be needed to supplement the control achieved by use of nonchemical control methods outlined above. *The use of toxicants should **not** be considered as the primary method of vole control.* The following materials are labelled for use in southern states.

<b>Rodenticide</b>	<b>Labelled for Use In:</b>
<i>zinc phosphide</i> ZP Rodent Bait-Ag Ridall-Z Roban II Zinc Phosphide Pellets	All states
<i>diphacinone</i> Ramik Brown Ramik Green	Georgia, North Carolina, South Carolina Missouri, Ohio, Virginia
<i>chlorophacinone</i> Razol "Paraffinized Pellets" Razol Ground Spray	Maryland, Missouri, North Carolina, South Carolina, Virginia

Zinc phosphide is an acute toxicant. A single feeding usually provides a lethal dose. Chronic rodenticides (anticoagulants) require multiple feedings over a several day period before a lethal dose will be obtained.

Zinc Phosphide 2 percent bait should only be used during the dormant season. It may be applied in any of the following ways:

- (1) Broadcast – Apply at a rate of 10 pounds per acre using mechanical spreaders into vegetative cover to reduce the potential for nontarget poisoning and to focus on areas in which voles are found.
- (2) Spot or trail baiting – Place 1 teaspoon of pellets in surface trails or at the mouths of holes leading to underground burrows. Two to four bait spots should be made near the base of each infested tree. Do not disturb the runway system and cover pellets by pulling overhanging grass back in place. Use 2 to 3 pounds of bait per acre.
- (3) Bait placement stations – Place 2 ½ ounces of bait under at least two established stations per tree. These stations should be established 2 to 3 months before baiting by placing rectangular (at least 15 inches by 15 inches) asphalt shingles or fiberboard rays, wood, or metal at the tree dripline. Car tires split horizontally and placed with the hollow side down and distributed one per tree every 10 trees provide a good place to set the bait. For pine vole control, place bait directly in tunnels or under stations.

Zinc phosphide is an acute dosage rodenticide and has an R safety code. When used improperly, it presents a serious nontarget risk – including to the applicator. It is highly toxic to all birds and mammals. Bait shyness may occur if voles receive a sublethal dose. They will then tend to avoid the bait. If other types of rodenticides are cleared for use in your state, retreatment with zinc phosphide should not be repeated within 6 months.

Anticoagulant rodenticides pose less of a risk to nontarget species (including the applicator) than zinc phosphide, making them the preferred choice in states where they are labelled for use.

*Ramik Brown* is formulated as a 0.005 percent bait and is placed by hand in vole runs at 10 pounds per acre or broadcast to vegetation under and around trees at 20 pounds per acre with a mechanical spreader. *Ramik Brown* is a continuous feed anticoagulant and will need to be reapplied in 21 to 30 days to ensure that voles in the nest at the first treatment are exposed. It has a safety code of C.

*Rozol Paraffinized Pellets* is formulated as a 0.005 percent bait. It is used for hand placement in vole runs at the rate of 10 pounds per acre or for broadcast to vegetation under and around trees with a mechanical spreader. *Rozol* is a continuous feed anticoagulant and has a safety code of C.

*Rozol* ground spray is formulated as a 5.34 percent EC and is used as a ground spray at one pint per 100 gallons and 600 gallons of spray per treated acre. It is an anticoagulant and has a safety code of D.

Always refer to the label for information on use, including states where certain rodenticides are labeled for use, rate, and timing.

### **Vole Monitoring**

The number of voles that can be tolerated is a trade-off between the cost of control and the cost of damage. It will vary with growers. Most damage occurs at high populations. Monitoring helps to determine when populations start to increase and when controls need to be started.

After harvest is the best time to check for the presence of voles. Runways free of growing vegetation and with bits of freshly cut vegetation and brown or green droppings shaped like rice grains constitute positive evidence of surface-feeding voles. Since pine voles do not use surface runways, they are harder to detect. Look for mounds of loose soil at push-up holes. Also, look for tiny, elongated tooth marks on apples laying on the ground.

Bait placement stations (concentration stations) put down 2 to 3 months before baiting may be checked for the presence of tunnels. Bait may be seeded directly into the tunnels and the station replaced. Check to see if the bait has been consumed after 2 weeks. If the bait is gone, assume that there is still an active population in that area and put down additional bait. If some bait remains, assume that voles using those tunnels have been controlled, and do not use additional bait under that station.

The apple sign test is a good indicator of vole activity. Select 40 to 50 trees scattered throughout the orchard but especially near the edges of areas with other kinds of vegetation. Check for the presence of holes and runs. Place a piece of asphalt roofing over a hole or run. After 1 week, check the shingle and place a piece of apple about the size of a quarter in the run or hole under the shingle. Check the next day and record whether the apple is missing, which is a positive sign for voles. Keep records on all the selected trees and use these same trees for a full year. It is not usually necessary to know the exact number of voles present, but it is good to know if the population is increasing or decreasing and whether a given treatment has had an effect on population size. To estimate the vole population, weigh the apple piece at the time it is put out and again 24 hours later. One pine vole consumes approximately 13 grams of apple in 24 hours. One meadow vole will consume about 20 grams of apple in this same time period. This is also an effective way to check the results of a rodenticide application.

**Trapping**, while not an effective means of controlling large vole populations, can be used to check for their presence and to aid in identifying the type of voles in the orchard. Mouse traps with expanded triggers may be placed perpendicular to runways, at the level of the runway using a piece of apple or a dab of peanut butter as bait. Fall through late winter is when voles should be easiest to trap. Select about 10 trees and place four traps per tree. Record the number of voles caught over a 3- to 5-day period. If the control program is successful, no more than two or three voles should be caught.

For surface-feeding voles, place traps in runways perpendicular to the direction of travel, even with the bottom of the runway and with the trigger in the runway. For pine voles, excavate a portion of a tunnel and set the trap perpendicular to the direction of travel and even with the bottom of the tunnel. Be sure to provide enough room for the trap to function properly. Cover the trap with something like a pot or bucket that will prevent light from reaching the trap yet not interfere with the operation of the trap.

Set traps in the afternoon and check them the following morning to lessen chances of other animals robbing or getting caught in the traps.

### **Tips to Increase the Effectiveness of Rodenticides**

- (1) Apply baits only in late fall and winter.
- (2) Do not apply baits to bare ground. Maintain a clean area extending out from tree trunks at least 3 feet.
- (3) Apply baits when no rain is expected for the following 3 days as wet weather may decrease the effectiveness of the bait.
- (4) Apply rodenticides by midafternoon as voles tend to be most active at dawn and at dusk.
- (5) Monitor to determine the types of voles present and to evaluate the effectiveness of the control program. This will allow for correct bait placement and for repeat bait applications if needed.
- (6) Where more than one type of rodenticide is labelled for use in the state, do not rely on repeat applications of zinc phosphide in a given season; voles will develop "bait shyness" to it, and it is a very toxic material.
- (7) Consider the use of rodenticides as only one part of a vole management program.

Depending only on rodenticides will result in poor control.

Voles probably account for more fruit tree decline and death than any other factor in U.S. orchards. Frequently, by the time vole damage is noticed, it is too late to save the trees. Even where damage has not led to tree death, several years of reduced yields and quality may pass before damaged trees completely recover. Vole control should be considered as a preventative program and should be an integral part of orchard management programs.

### **Beavers (*Castor canadensis*)**

Beavers can damage orchards by cutting down trees or by flooding portions of orchards. Access to orchards may be blocked if beaver activity floods roadways. Regulations regarding beaver control may vary from state to state. Therefore, before initiating a control program, be sure to check with the local wildlife resources agency to determine which options are available.

Relocation, repellents, and fumigation of dens are not recommended control practices. Relocation is costly, affected beavers may not survive, and moving beavers to another area only transfers the problem to others. Also, it

is illegal to relocate beavers in North Carolina. Repellents are ineffective. Fumigation of beaver dens is not an approved practice.

Effective control options include fencing beavers out of the area, using water-level control structures that beavers are not as apt to bother, and removing the beaver population. Removal of the population may be accomplished by shooting, trapping, or a combination of the two. Trapping is the desired method of removing an entire colony in small watersheds and farm ponds. Regardless of the method used, it is easier to take care of beaver problems when they first occur.

More detailed information on beaver control may be found in the appropriate fact sheet listed below.

### **Suggested References for Vertebrate Management**

Wildlife Damage Management Fact Sheet AG-472-4, *Beavers*, available on the Internet at:  
<http://www.ces.ncsu.edu/nreos/wild/wildlife/wdc/beaver.html>

Wildlife Damage Management Fact Sheet AG-472-1, *Voles in Commercial Orchards and Ornamental Nurseries*, available on the Internet at <http://www.ces.ncsu.edu/nreos/wild/wildlife/wdc/voles.html>

Printed copies of the above references may be obtained by contacting Communication Services, Box 7603, NC State University, Raleigh, NC 27695-7603.

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