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Voles

Integrated Pest Management for Home Gardeners and Landscape Professionals

Voles are mouselike rodents somewhat similar in appearance to gophers. Six species of voles from the genus *Microtus* occur in California. Collectively they are called either meadow mice or voles. Two species are responsible for the majority of damage. The California vole, *M. californicus* (Figure 1), is the most widespread vole in the state, found in the Owens and Central valleys and nearly the entire length of the coastal range. The montane vole, *M. montanus*, inhabits northeastern California and the eastern Sierra slope. Voles usually do not invade homes and shouldn't be confused with the house mouse, *Mus musculus*.

Voles are intriguing small mammals because some populations regularly go through cycles of low to high numbers with occasional sudden increases that can send numbers soaring up to several thousand per acre.

Figure 1. Vole (meadow mouse).

Figure 2. Vole runway with fresh fecal pellets indicating current use of adjacent burrow system.

IDENTIFICATION AND BIOLOGY

Voles have a compact, heavy body, short legs, a short-furred tail, small eyes, and partially hidden ears. Their long, coarse fur is blackish brown to grayish brown. When fully grown they can measure 5 to 8 inches long, including the tail.

Although voles spend considerable time above ground and you occasionally can see them scurrying about, they spend most of their time below ground in their burrow system. The clearest signs of their presence are the well-traveled, aboveground runways that connect burrow openings (Figure 2). A protective layer of grass or other ground cover usually hides the runways. The maze of runways leads to multiple burrow openings that are each about 1-½ to 2 inches in diameter. You can locate the runways by pulling back overhanging ground cover. Fresh clippings of green grass and greenish-colored droppings about 3⁄16 inch long in the runways and near the burrows are further evidence of voles. With age, the droppings lose the green coloring and turn brown or gray.

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Voles are active day and night, year-round. You'll normally find them in areas with dense vegetation. Voles dig many short, shallow burrows and make underground nests of grass, stems, and leaves. In areas with winter snow, voles will burrow in and through the snow to the surface.

Several adults and young can occupy a burrow system. The size of the burrow system and foraging area varies with habitat quality, food supply, and population levels, but in most cases, it is no more than a few hundred square feet.

Vole numbers fluctuate from year to year, and under favorable conditions, their populations can increase

rapidly. In some areas their numbers are cyclical, reaching peak numbers every 3 to 6 years before dropping back to low levels. Voles can breed any time of year, but the peak breeding period is spring. Voles develop rapidly, with females maturing in 35 to 40 days and having 5 to 10 litters per year. Litter size ranges from 3 to 6 young. However, voles seldom live longer than 12 months.

Voles are mostly herbivorous, feeding on a variety of grasses, herbaceous plants, bulbs, and tubers. They eat bark and roots of trees, usually in fall or winter, although damage can occur throughout the year. Voles store seeds and other plant matter in underground chambers.

Voles are poor climbers and usually don't enter homes or other buildings. Instead, they inhabit wildlands or croplands adjacent to buildings, gardens, and landscaped sites with protective ground cover (e.g., vegetation, mulch, and weed cloth). Most problems around homes and gardens occur during outbreaks of vole populations.

DAMAGE

Voles cause damage by feeding on a wide range of garden plants including artichoke, beet, Brussels sprouts, cabbage, carrot, cauliflower, celery, lettuce, spinach, sweet potato, tomato, and turnip. They also can damage turf and other landscape plantings such as lilies and dichondra. Voles will gnaw the bark of fruit trees including almond, apple, avocado, cherry, citrus, and olive. Vole damage to tree trunks normally occurs from a few inches above ground to a few inches below ground. If the damage is below ground, you will need to remove soil from the base of the tree to see it. Voles are poor climbers, although they can cause damage higher up on trees if they can access low-hanging branches. Voles may also puncture irrigation lines through chewing activity, resulting in leaks and costly repairs.

Vole damage is identified by gnaw marks on trees about ⅛ inch wide and ⅜ inch long in irregular patches and various angles, along with other signs including droppings, runways, and burrows. If voles gnaw completely around the trunk or roots, it will disrupt the tree's flow of nutrients and water, a process known as girdling (Figure 3). Girdling damage on trunks and roots can kill trees. Signs of partial trunk or root girdling can include a prolonged time before young trees bear fruit, reduced fruit yield, abnormal yellowish leaf color, and overall poor vigor. Where snow cover is present, damage to trees can extend a foot or more up the trunk. Damage that occurs beneath snow cover often escapes notice until it is too late. Pocket gophers are another rodent species that will cause girdling damage to trunks. Vole girdling damage can often be distinguished from pocket gopher damage by the location of where the girdling damage occurs. Vole girdling damage generally occurs aboveground, while similar pocket gopher damage generally occurs below ground. That said, vole damage can occasionally occur up to a few inches below ground. As such, observation of other signs of rodent presence (such as open burrow entrances compared to closed pocket gopher mounds) may be needed to determine the offending animal.

LEGAL STATUS

The California Fish and Game Code classifies voles as nongame mammals, meaning if voles are injuring or threatening growing crops or other property, the owner or tenant of the property has permission to control them at any time and in any legal manner.

MANAGEMENT

To prevent vole damage, you need to manage the population in your area before it reaches high numbers. You often can achieve this by removing or reducing the vegetative cover, making the area unsuitable to voles. Removing cover also makes detecting voles and other rodents easier. Once vole numbers begin to increase rapidly, the damage they do to ornamental and garden plants and to trees can be quite severe.

Figure 3. Girdling damage to tree bark caused by voles.

Monitoring Guidelines

Be alert for the presence of voles. Look for fresh trails in the grass, burrows, droppings, and evidence of feeding in the garden and surrounding area. Pay particular attention to adjacent areas that have heavy vegetation, because such areas are likely sources of invasions.

Habitat Modification

One way to effectively deter vole populations is to make the habitat less suitable to them. Weeds, heavy mulch, and dense vegetative cover encourage voles by providing food and protection from predators and environmental stresses. If you remove this protection, their numbers will decline.

Reduce the area from which voles can invade gardens or landscaped areas by regularly mowing, spraying with herbicides, grazing, or tilling grassy areas along ditch banks, rights-of-way, or field edges adjacent to gardens. A 4-foot-diameter circle around the base of young trees or vines that is free of vegetation or a buffer strip 4 feet or more along a row of trees can reduce problems because voles prefer not to feed in the open.

Exclusion

Wire fences or aluminum flashing at least 12 inches above the ground with a mesh size of ¼ inch or smaller will help to exclude voles from the entire garden. These fences either can stand alone or be attached to the bottom of an existing fence (Figure 4). Bury the bottom edge of the fence 6 to 10 inches to prevent voles from tunneling beneath it. A weed-free barrier on the outside of the fence will increase its effectiveness.

Protect young trees, vines, and ornamentals from girdling by using cylinders made from hardware cloth, sheet metal, or heavy plastic that surround the trunk (Figure 5). Support or brace these devices, so they can't be pushed over or pressed against the trunk. Also make sure there is enough space between the protector and trunk to allow for tree growth and, in areas with snow, are tall enough to extend above snow level. Bury the bottom of the protective device 4–6 inches below the soil surface to prevent voles from digging beneath it. Frequently check protective devices to make sure meadow mice haven't gnawed through or dug beneath the cylinders and are hiding inside the tree guard while they feed on the tree.

Trapping

When voles numbers are low or when the population is concentrated in a small area, trapping can be effective. Use a sufficient number of traps to control the population. For a small garden, a dozen traps is probably the minimum number required, but for larger areas, you might need 50 or more. Common traps include standard mouse snap traps.

Trap placement is crucial (Figure 6). Voles seldom stray from their runways, so set traps along these routes. Look for burrows and runways in grass or mulch in or near the garden. Place the traps at right angles to the runways with the trigger end in the runway. Traps can generally be left unbaited, as voles will cross the trap as they run

Figure 4. Aluminum flashing as a fence to limit vole movement into unwanted areas.

along their runways. If bait is desired, a peanut butter-oat mixture or apple slices often work well. However, if applying bait to traps, the traps should be enclosed to minimize the chance that nontarget birds will be captured. A piece of gutter placed over the trap and along their runways can provide a good cover.

Examine traps daily, removing dead voles or resetting sprung traps as needed. Continue to trap in one location until you stop catching voles, then move the trap to a new location 15 to 20 feet away. Destroy old runways or burrows with a shovel or rototiller to deter new voles from immigrating to the site.

Bury dead voles, or place them in plastic bags in the trash. Because voles can carry infectious pathogens or parasites, don't handle them without rubber gloves; you can use a plastic bag slipped over your hand and arm as a glove. Once you have removed the vole from the trap, hold it with your "bagged" hand and turn the bag inside out while slipping it off your arm and hand. Be sure to keep small children and pets out of areas where you have set traps.

Biological Control

Many predators including coyotes, foxes, badgers, weasels, cats, gulls, and

Figure 5. A plastic cylinder protects the trunk of this young tree from vole damage

Figure 6. Vole snap trap placement.

especially hawks and owls eat voles. However, in most cases predators can't keep vole populations below damaging levels. Many predators simply don't hunt close to homes and gardens where control is needed. Implementation of a network of barn owl nest boxes to increase biological control from raptors may be more appropriate and successful in larger areas of open habitat, such as in parks or grasslands, outside of or on the outskirts of cities. Such use of barn owl nest boxes has resulted in some

reduction in pocket gopher populations in vineyards in California, but it is yet unproven if they can reduce vole populations.

Most predators, including barn owls (Figure 7), have a broad diet and readily shift to alternative prey when the number of voles declines. Predators rarely, if ever, take every last vole; thus, a residual population will always remain. With their extremely high reproductive potential, any remaining voles could repopulate an area in a short period. With this potential for severe damage, the reliance on natural control by a home gardener or landscape manager is risky and likely to be unsuccessful. The use of habitat modification, exclusion, trapping, and baiting offers more immediate and reliable control in target locations.

As with all animals, natural constraints limit vole numbers. Because populations won't increase indefinitely, one alternative is to do nothing, and let nature limit the voles. However, around homes and gardens, the natural population peak is generally too high, and damage will be above tolerable limits.

Baiting

When voles are numerous or when damage occurs over large areas, toxic baits can be a quick and effective means of control. Take necessary measures to ensure the safety of children, pets, and nontarget animals, and follow all product label instructions carefully.

First-generation anticoagulants (e.g., warfarin, chlorophacinone, and diphacinone), often referred to as multiple-feeding baits, interfere with an animal's blood-clotting mechanisms, eventually leading to death. They are the safest type of rodent bait for use around homes and gardens because they are slow acting, generally require consumption over the course of several days to be effective. First-generation anticoagulants have an effective antidote, vitamin K1, making them safer to use around children and pets. Second-generation anticoagulants (e.g., brodifacoum, bromadiolone, difethialone, and difenacoum) historically used to control roof rats (*Rattus rattus*), Norway rats (*Rattus norvegicus*), and house mice (*Mus musculus*) are not legal for use against voles. Check the label carefully to ensure the bait is legal for use on voles or meadow mice.

Application strategies for first-generation anticoagulants varies depending on the product, so be sure to read the entire label to understand limitations for use in your setting. In general, bait station applications are the most common approach for voles in residential landscape settings. Baits are applied within bait stations in areas with abundant vole activity. Stations should be operated for at least 15 days to take advantage of the multiple-feeding properties of the active ingredient. If continued feeding occurs after 15 days, the stations should remain in place until feeding ceases.

Some restricted-use products (i.e., those that require the applicator to be licensed or certified to apply the product) also allow for first-generation anticoagulants to be applied via spot treatments or within-burrow applications in residential areas. Within-burrow treatments entail the application of a specified amount of bait directly into a burrow entrance, while spot treatments allow for the scattering of bait in a small area on vole runways or around vole entrances. Spot treatments generally require the bait to be covered by a board, tarp, vegetation, or similar structure to deter consumption by nontarget species. Depending on the product, repeat applications may be required to take advantage of the repeat-feeding requirement for these active ingredients.

Zinc phosphide is another restricted-use toxicant that can be used to manage voles in some residential settings. Zinc phosphide is an acute toxicant that kills the animal after a single feed. It is only available for use in non-residential lawns, ornamentals, golf courses, and parks, and is applied via spot treatments or bait stations. For spot treatments, care should be taken to cover bait with a board, tarp, vegetation, or similar structure to deter nontarget consumption. This is particularly important for zinc phosphide given that it is an acutely toxic rodenticide for which no antidote is available.

Figure 7. Adult barn owl.

Repellents

Commercial repellents are sometimes used to protect plants from voles. A variety of active ingredients are available including capsaicin and castor oil. However, the efficacy of vole repellents is questionable, and their use often is not practical. You must apply them before damage occurs. Voles usually damage plants at or just beneath the soil surface, making adequate coverage difficult or impossible. Don't apply repellents to food crops unless the product label specifies such use.

Other Control Methods

Burrow fumigants such as gas cartridges aren't effective for controlling voles because their burrow system is shallow and has numerous open holes. Electromagnetic or ultrasonic devices and flooding in landscape settings are ineffective against voles.

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Range maps
M. californicus: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2538&inline=1
M. montanus: https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentID=2536&inline=1

WARNING ON THE USE OF PESTICIDES

Pesticides are poisonous. Some pesticides are more toxic than others and present higher risks to people, nontarget organisms, and the environment. A pesticide is any material (natural, organic, or synthetic) used to control, prevent, kill, suppress, or repel pests. "Pesticide" is a broad term that includes insecticides, herbicides (weed or plant killers), fungicides, rodenticides, miticides (mite control), molluscicides (for snails and slugs), and other materials like growth regulators or antimicrobial products such as bleach and sanitary wipes that kill bacteria.

Always read and carefully follow all precautions and directions provided on the container label. The label is the law and failure to follow label instructions is an illegal use of the pesticide. Store all chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, and animals. Never place pesticides in food or drink containers. Consult the pesticide label to determine active ingredients, correct locations for use, signal words, and personal protective equipment you should wear to protect yourself from exposure when applying the material.

Pesticides applied in your garden and landscape can move through water or with soil away from where they were applied, resulting in contamination of creeks, lakes, rivers, and the ocean. Confine pesticides to the property being treated and never allow them to get into drains or creeks. Avoid getting pesticide onto neighboring properties (called drift), especially onto gardens containing fruits or vegetables ready to be picked.

Do not place containers with pesticide in the trash or pour pesticides down the sink, toilet, or outside drains. Either use all the pesticide according to the label until the container is empty or take unwanted pesticides to your local Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Hazardous Waste Collection site nearest you. Follow label directions for disposal of empty containers. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

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