VOLES IN MONTANA
THEIR BIOLOGY, DAMAGE AND CONTROL

MONTANA DEPARTMENT OF AGRICULTURE
BOX 200201
HELENA, MT 59620-0201

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VOLE IDENTIFICATION

Voles (often called meadow or field mice) have stocky bodies with short legs and short or long tails depending on the species (Fig. 1). They vary from gray to dark brown in color. Their eyes are small and the ears are inconspicuous.

Fig. 1. Meadow vole.

Montana hosts eight species of voles. Four species, the Heather vole (*Phenacomys intermedius*), Sagebrush vole (*Lemmiscus curtatus*), Southern red-backed vole - *Myodes gapperi*), and Water vole (*Microtus richardsoni*) rarely cause conflicts with human interests. The remaining four, however, are associated with significant economic damage and will be the focus of this bulletin. These four species and their habitats are:

Long-tailed vole (*Microtus longicaudus)*: 6 to 8½ inches long (nose to tip of tail); tail length is more than 50 percent of body length; gray to dark brown with grayish- white or yellowish under parts; found in a wide variety of habitats throughout Montana except the far eastern edge.

Meadow vole (*Microtus pennsylvanicus)*: 5½ to 7½ inches in total length; the tail is short and only 25 percent of the vole's total length; the fur is gray to yellow-brown with black tipped guard hairs; the most common and widely distributed vole species in Montana and is usually found in moist, grassy habitats.

Montane vole, or Mountain vole (*Microtus montanus*),: 5½ to 8½ inches in total length; brown with silver-gray feet and whitish under parts; short tail; found in dry grass-lands to moist meadows from valleys to tundra in the western half of Montana.

Prairie vole (*Microtus ochrogaster)*: 5 to 7 inches in total length; gray to dark brown in color found in the drier prairie habitats of central and eastern Montana. This species spends more time underground than all other species of voles in Montana.

While some species of voles have physical characteristics that allow easy field identification (i.e. long-tailed vole), others require careful scrutiny. For example, the only reliable way to distinguish meadow voles from montane is by examining the middle molar of the upper jaw. The molar of the meadow vole has five islands, whereas the molar of the montane vole has only four. As a rule, don't rely solely on color or size as vole hair can vary within the same species. Likewise, weight cannot be used as voles undergo significant changes as they fatten for winter.

Other characteristics to look for when identifying voles.

1. Meadow voles have six plantar nodes on their hind feet whereas the Prairie vole has five.
2. Female Meadow and Montane voles have four pairs of mammary glands whereas the Prairie vole has only three.
3. Tail of the Montane vole is ⅓ the total length of the vole's head and body.

Other rodent species that may occupy similar habitat that are sometimes confused with voles include the Deer mouse (*Perimiscus maniculatus*; Fig. 2) and the Northern pocket gopher (*Thomomys talpoides).* These species are easily distinguished from voles by appearance and habits.

Fig. 2. Deer mouse.

Deer Mouse
Deer mice are strongly bi-colored with tannish-brown backs and white stomachs, large ears and eyes, and a long bi-colored tail. Deer mice are widely distributed and found in many habitats. Deer mice do not make ground surface runways or tunnel systems and leave little sign of their presence. They are predominately seed eaters. Deer mice commonly occupy homes and other structures.

Pocket Gophers
Pocket gophers are somewhat similar to voles in appearance but are larger and better adapted for digging. They inhabit closed, underground burrow systems and are seldom seen above ground. The presence of pocket gophers is evident by the presence of mounds of soil excavated from underground burrows that have no obvious opening to the burrow system. Pocket gophers feed on plant roots that they search for by digging shallow burrows beneath the ground surface.

VOLE HABITAT
In general, voles prefer areas with a dense ground cover of grasses and litter. They live in underground tunnel systems with open entrances approximately 1 to 2 inches in diameter. These burrow openings are connected by a maze of one to two inch wide surface runways over the ground usually beneath vegetation or litter (Fig. 3). Interestingly, long-tailed voles tend not to create surface trails.

Fig. 3. A vole burrow (below ruler) and runs.

Feces and small pieces of vegetation may be found in these runways. Vegetation near runways may be clipped to ground level. Stripping and gnawing of the bark of shrubs or trees may indicate the presence of voles.

In addition to natural habitats, voles will occupy areas modified by humans, such as orchards, reforested areas, windbreaks, lawns, nurseries, golf courses, cemeteries, and agricultural fields, such as hay and alfalfa. Voles do not generally inhabit buildings or structures.

FOOD HABITS
Voles eat a wide variety of plants consisting primarily of grasses and forbs. They also readily consume seeds, bulbs, rhizomes, tubers and perhaps some insects. In fall and winter when grasses are dry or decomposing, voles may strip the bark of trees and shrubs and consume the cambium layer. Voles can cause significant economic damage to agricultural crops, particularly when populations are high.

BIOLOGY, REPRODUCTION, AND BEHAVIOR
Voles live in a complex system of tunnels inter-connected by runways along the ground surface. Their home range is about ¼ acre and a single tunnel system may contain several adults and numerous young. Voles do not hibernate and are active day and night throughout the year.

Voles normally breed in the spring and summer but may continue throughout the year. They produce one to five litters per year, per female with an average of five or six young per litter. The gestation period is 21 days and females are sexually mature in 35 to 40 days. The life span of voles is short with many voles dying within the first month. Voles rarely live longer than 16 months.

Vole population densities fluctuate widely from year to year. Population numbers can range from several voles per acre to several thousand per acre.

Although populations usually peak every two to five years, these cycles are not predictable. However, researchers believe that warm winters coupled with early spring rain may provide environmental conditions conducive to eruptions in vole populations. On the other hand, high vole populations often decline suddenly because of food shortages or diseases.

DAMAGE
Damage caused by voles can occur in many forms and degrees of severity, depending on population numbers and environmental conditions. Most

damage consists of gnawing, clipping, and eating plants. Damage usually occurs in fields, orchards or other outdoor locations since voles rarely occupy buildings, storage facilities, or homes.

Voles eat agricultural crops such as alfalfa, clover, sugar beets, grains, potatoes and other vegetables. Such damage is usually directly proportional to vole population numbers. Burrowing activities and tunnel systems may disrupt irrigation and possibly undermine embankments and earthen dikes.

During winter months or times of drought, voles often move from surrounding areas into yards, gardens, golf courses or cemeteries. They may burrow and create runways that damage lawns (Fig. 4) or gnaw and consume flowers and bulbs (Fig. 5).

Fig. 4. Vole run that cut through the grass.

Fig. 5. A beet damaged by hungry voles. Nickel used for scale.

Orchards, shelter belts and nurseries can experience damage when bark is shredded and the cambium layer is gnawed and eaten (Fig. 6). If 50 percent or more of the circumference is damaged, the tree or shrub will likely die. This type of damage occurs most often during fall and winter.

Fig. 6. A close-up of vole damage on the trunk of an apple tree.

Voles gnaw in a manner that helps distinguish their damage from other species. Voles gnaw in irregular patches and at various angles. Teeth marks are about ⅛-inch wide, ⅜-inch long, and 1/16 inch or more deep. Vole damage also may be distinguished by the height. Voles gnaw bark on the lower portions of a tree up to the snow line.

Vole Damage Assessment. Due to their ability to reproduce rapidly in short periods of time (known as irruptions) and to damage crops significantly before being noticed, producers must monitor their fields and act when vole numbers become too high. Monitoring is most critical in the early spring (pre-thaw). The goal is to identify vole issues and address them before planting since voles do most of their damage in the early stages of crop development.

As a general rule, producers should consider controlling voles when colonies, identified by groups of one-inch holes, reach four to five per acre. Alternatively, producers can set traps (several dozen to an area) and monitor the catch rate. If trapping success is greater than 10 percent, then control should be initiated. For example, if 36 traps are set in a field and four voles are caught by the next day, initiate control activities.

VOLE DAMAGE CONTROL

Best results occur when multiple control methods are employed. Seldom will a single solution or method resolve a vole problem. Select the methods appropriate to your situation based on cost, time, labor, size of area affected, vole population numbers, environmental conditions, effect on non-target species and personal control philosophies.

Habitat Modification and Cultural Methods
Modifying vole habitat and initiating certain cultural practices can reduce the occurrence and severity of vole damage. Removal of ground cover and litter can greatly reduce vole numbers. Where practical, create a weed-free zone that is 10 feet or more in width as voles voles avoid crossing bare ground that is more than 10 feet wide.

Keep lawns, turf, ornamental areas and orchards mowed. Clear mulch and litter three feet (or more) from the base of trees. Adjacent crop fields and irrigation systems can be protected by mowing, spraying or grazing ditch banks, rights of-way and water ways. Destroy vole runways, and burrow systems, cover and food supplies by tilling soil. Flood irrigation can reduce numbers of voles and other rodents in fields. However, be sure to initiate control in non-flooded areas as voles will flee to unflooded areas.

Predation
Voles provide a prey base for a variety of predators, including foxes, coyotes, weasels, hawks, owls and snakes. However, factors affecting vole reproduction such as postpartum breeding, early maturity, synchronous breeding, and high reproductive potential prevent predators from eliminating vole populations or substantially reducing their numbers. Nevertheless, since predators consume large numbers of voles and reduce spikes in vole populations, their presence should be encouraged in any integrated vole control program.

House cats should not be used to control voles. While cats do kill voles, they also indiscriminately kill valuable native animals, such as birds and amphibians. In addition, free-range cats spread the parasite that causes Toxoplasmosis through their feces, thereby contaminating the environment and posing risk of infection to other animals and people.

Exclusion
Voles can be excluded from unwanted areas, such as gardens, by installing ¼-inch hardware cloth at least six inches below the ground and extending at least 14 inches above ground. Prevent voles from climbing over the fence by bending the top two inches of the fence away from the area you wish to protect at a 90° angle or attach a 4inch strip of flashing at the top of the fence to prevent voles from gaining a toe-hold. Be sure that fence posts are placed on the side of the fence you wish to protect to prevent voles from climbing the poles. While exclusion is effective, landowners must weigh the benefits with the cost of installation.

Protect seedlings or young trees with metal flashing cylinders or rodent proof wraps. These barriers should be buried several inches beneath the soil surface and extend up the trunk of the tree beyond expected snow depth. Secure the top of the cylinders with mesh to prevent entrapment by crevice dwelling birds (Fig. 7).

Fig. 7. Corrugated pipe (black) used to protect a tree.

Alternative Feeding
Alternative feeding involves providing food to voles to distract them from feeding on desirable foods. This method is usually used during planting to protect seeds from being foraged by voles. The technique involves spreading 110.5 pounds of seed per acre. Use the same grain to distract the voles as the grain being planted.

Note that the use of alternative feeding should be on an emergency basis and not be part of an annual routine. Even when planted seeds are protected, the voles can do more damage in the future.

Repellants
Capsaicin, the ingredient of chili peppers that makes them hot, is registered as a repellent for voles in Montana. Due to its irritating qualities (burning of eyes, mouth, etc.), applicators must follow safety guidelines as well as avoid applying the product where it may enter the food supply.

Capsaicin may be sprayed on non-crop/feed plants, such as ornamental trees, shrubs, fruit bushes and vines. Capsaicin is also formulated to be absorbed in the roots of trees and non-crop plants and act as a systemic repellent (Repellex®). The product may be applied to fruit-bearing plants up to 60 days of harvest or after harvest. On crops, the product may only be applied up to the time edible portions form.

Predator urines, such as bobcat, fox and coyote, have shown promise as repellents for voles. However, the concentrations required to achieve noticeable results make these products impractical. In addition, urines not properly sterilized have the potential for exposing applicators to harmful diseases.

The fungicide, Thiram, has been found to reduce vole feeding activity. While the product cannot be used to control damage by voles, producers needing to control a fungus may want to use Thiram if their plants are suffering damage by voles.

Readers choosing to use repellents should have reasonable expectations. Repellents work best when animals have alternative food sources. Without alternative foods, it is unlikely that repellents will achieve desired results.

Fumigants

Vole burrows are too complex and porous for fumigant gases to be effective. Therefore, fumigants of any kind, including propane-oxygen exploders, are not recommended.

Trapping

Trapping is a great tool for identification of voles, for monitoring vole numbers and controlling voles in a few acres. Voles can be caught easily in unbaited mouse snap traps by placing the traps perpendicular to the runways with the trigger (expanded triggers are best) in the runway (Fig. 8).

Baited snap traps are also effective but should be protected by an overhead cover to reduce attracting and injuring non-target animals, such as birds. Covers can be as simple as propping boards up with bricks or as fancy as fabricated triangular covers that may be staked to the ground (Fig. 9). Always ensure covers will not interfere with the firing of the traps. Effective baits include, apple slices or a peanut butter/oat mixture.

Fig. 8. Expanded trigger snap trap (unbaited) properly set in a vole run.

Fig. 9. (Top) A couple of baited-traps may be protected with a simple waxed cardboard from a milk container. (Bottom) Protect large numbers of baited traps with a triangular wooden cover. Master trapper Rick Shadel of PA, pictured.

Multiple-catch mouse traps, such as the Tin Cat® and Ketch-All®, also are effective in catching voles (Fig. 10). Simply place the openings directly in line with the vole trails. Bait is not required. When checking multiple-catch traps, use care when opening as live voles may endeavor to escape. Wear gloves when setting and checking traps to protect against cuts and scrapes and from having direct contact with the captured voles.

Fig. 10. A Ketch-All trap placed in a vole run.

Toxicants

Registered General Use Pesticides (GUP) for the control of voles in Montana include, warfarin, chlorophacinone, diphacinone, difethilone, bromadiolone, brodifacoum, bromethalin and zinc phosphide. All GUPs may be applied only within 100 feet (or less) of structures. If the toxicant is used above ground and outdoors, most labels require that the toxicant be placed in tamper-resistant bait stations that are capable of resisting entry to larger wildlife, and secured to prevent children from shaking bait out of the compartments.

When using manufactured bait stations (Fig. 11), be sure to use mouse-sized bait stations as the

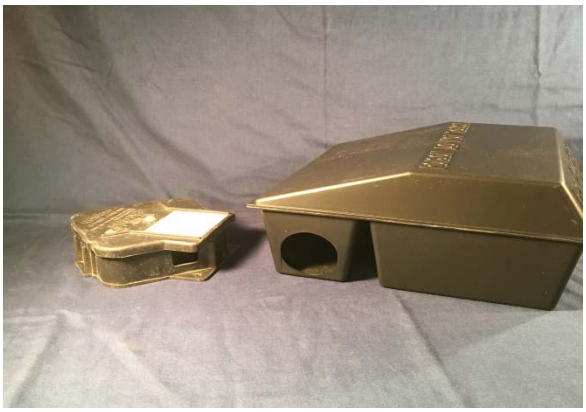

Fig. 11. (Left) Mouse-sized bait station suitable for voles compared to the rat-sized bait station (right).

smaller hole size will prevent larger animals from accessing the bait. If using rat-sized bait stations, then reduce the hole size 1 to 1¼ diameter. In addition, use stations designed for outside use as they are made from more durable materials than those designed for indoor use. Manufacturers and pesticide suppliers can provide suggestions for the proper anchoring of bait stations.

Inverted T-style bait stations (Fig. 12) can be made from 2 inch PVC pipe. Each wing is 12 inches (or longer) with a cap, and t-connector. Reduce the size of each end with a piece of PVC or aluminum flashing to prevent bait from spilling out. Do not narrow the opening to less than 1 inch. Inverted T-style stations may be anchored to a stake or trees with zip ties.

Fig. 12. (Top) T-style bait station using 2-inch PVC pipe. (Bottom) Close up of the end showing the end plate to prevent bait from spilling out of the station.

Whenever applying first generation anticoagulants (i.e. warfarin, chlorophacinone, diphacinone,) it is critical to maintain the bait supply for the number of days recommended by the label. Failure to maintain the bait supply will result in ineffective control because voles may receive a sub-lethal dose and upon recovering may avoid future bait application.

Restricted Use Pesticides (RUP) can be used to control voles in a variety of sites including tree nurseries, non-crop areas, turf, orchards, vineyards, airports, and crops, such as wheat,

barley, alfalfa and cucurbits. Applications are generally restricted to periods of dormancy or post-harvest to prevent toxicants from entering the food supply. Only two active ingredients are registered as RUPs, zinc phosphide and chlorophacinone. Read and follow all label instructions.

Zinc phosphide bait is the primary toxicant used in agricultural settings. Depending on the label it may be applied by hand, broadcast by hand, machine, or air, and placed in bait stations. Due to its importance, it is essential that applicators understand the benefits and limitations of zinc phosphide as a toxicant for control of voles.

Toxicant Safety

Hazard to non-target animals from toxic baits is present in two ways: primary poisoning with direct consumption of the bait material; and secondary poisoning with consumption of poisoned vole carcasses by predators and scavengers. Non-target animals most at risk from primary poisoning include domestic livestock and poultry and certain species of seed-eating birds, such as waterfowl, grouse and some songbirds. Hazards from primary poisoning can be reduced by following pesticide label directions and precautions as well as common sense safety practices such as:

1) Pick up spilled bait and dispose of it according to the label.

2) Use calibrated dippers or spoons for applying bait. Apply only the label recommended amount. Scatter the bait along runways and near burrow openings. Do not pile the bait because this increases hazard to livestock and wildlife.

3) Remove livestock from treated areas when possible. In addition to reducing the risk of poisoning livestock, vole control will improve as livestock will not trample bait placements.

4) Consider additional precautions, such as patrolling treated areas and frightening non-target animals and birds away.

5) Keep baits in original, labeled, containers and store in secure, weather tight, areas.

Secondary hazards from anticoagulants are of most concern with dogs, foxes, coyotes, and other canids. Voles poisoned with an anticoagulant generally die below ground in their burrows. Some will die above ground and if found should be buried to reduce the risk to scavengers. Always notify neighbors of your bait applications. Suggest confinement of dogs, cats or other animals during the application and for two weeks afterward. In warm weather, carcasses decompose rapidly and present little hazard after 5 to 10 days.

Secondary hazard from zinc phosphide is considered low because zinc phosphide is metabolized in the presence of digestive acids and poses little to no residual toxicity. Secondary hazard can occur when treated bait does not reach digestive acids, such as seeds held in the mouth of the animal, which is then consumed by a predator or scavenger.

DISEASE

Although capable of carrying disease organisms, such as plague, tularemia and Hantavirus, voles rarely transmit diseases to humans because of infrequent contact. Voles tend not to inhabit homes and other structures like deer mice, house mice and pack rats do. However, people who trap or handle rodents directly should wear protective clothing and gloves. In addition, consider using an insect repellent containing DEET to reduce attracting fleas which may leave voles to bite you. Contact public health officials or official publications for further information.

DEPARTMENT SERVICES

As with most programs, rodent control will be most effective when all affected landowners work together. The Montana Department of Agriculture vertebrate pest specialist program will work with county commissioners, extension agents and landowners to establish a program suited to local and county needs. Field demonstrations are provided to inform landowners how, when, and where to control voles and other field rodent pests. Interested individuals should contact the Montana Department of Agriculture.

In Lewistown:
Stephen M. Vantassel,
Vertebrate Pest Specialist
Phone (406) 406-538-3004 svantassel@mt.gov

In Helena:
Linda Johns, Program Supervisor
Phone - (406) 444-3676
ljohns@mt.gov

Additional printed information on the control of voles and other vertebrates is available from the Montana Department of Agriculture website http://agr.mt.gov/Programs/Pesticides/VertebratePest/Bulletins/

MONTANA POISON CONTROL
(Emergencies)
1-800-222-1222

MONTANA DEPARTMENT OF PUBLIC HEALTH & HUMAN SERVICES
Injury Prevention Program
1-406-444-4126
http://dphhs.mt.gov/publichealth/EMSTS/prevention.aspx

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