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Wildlife Damage Management Series

Commensal Rodents

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Jack H. Berryman Institute
Utah Division of Wildlife Resources
Utah Department of Agriculture and Food
USDA/APHIS Animal Damage Control

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The term "commensal" means "living with or in close association to humans." Although many species of rodents occasionally may be found around humans, the term commensal rodents refers specifically to mice and rats. In Utah, house mice (*Mus musculus*) and Norway rats (*Rattus norvegicus*) are the most common commensal rodents (Figure 1).

Almost everyone is familiar with the appearance of house mice and Norway rats. House mice are small (< 8 inches in total length) rodents with a slender body, pointed nose, and small protruding eyes. The tail of house mice is hairless with obvious scale rings. White-footed mice and harvest mice are often mistakenly identified as house mice. Norway rats are much larger than house mice (12 to 18 inches in total length) and appear stocky. Norway rats and house mice are not a native species in North America, but were transported from Europe to the U.S. during colonial settlement.

GENERAL BIOLOGY AND BEHAVIOR

House mice are nocturnal, although in some areas they may be active during the day. House mice often burrow into and nest in the ground or under structures

Figure 1. Norway rat, *Rattus norvegicus* (left), and house mouse, *Mus musculus* (right).

when other shelter is not available. In most areas, the beginning of cold weather in the fall will cause mice to search for shelter in houses, barns, or granaries. These structures can support very large populations of mice if control measures are not taken. Mice nests are constructed of fibrous material that may include paper, burlap, or fabric and often are found under floors and in the walls of buildings. House mice are extremely prolific and breed year-round. Females can produce as many as 13 litters each year ranging in size from 3 to 10. Following birth, young mice grow rapidly and reach sexual maturity when they are 6-8 weeks old.

Like mice, Norway rats are also nocturnal animals that become active at dusk, when they begin to seek food and water. Rats are often found in houses, farm buildings, and warehouses and frequent the walls, floors, and foundations of these buildings. Rats construct nests similar to that of house mice, but rat nests are much larger. Norway rats are prolific breeders and can breed throughout the year. Under favorable conditions, female rats can birth as many as 8 litters per year. Litters can include as many as 15 young, but typical litter sizes range from 6 to 8. Young rats mature quickly, being weaned at 3 weeks old and reaching sexual maturity within 3-4 months.

COMMENSAL RODENT PROBLEMS

House mice and Norway rats are considered two of the most destructive and costly wildlife species that exist in the U.S. Unfortunately, accurate estimates of the economic costs of mouse and rat damage are lacking. In one study, 76% of grain samples in a Midwestern state were contaminated with mouse droppings. Another study discovered that a small colony of Norway rats could contaminate 70% of wheat in 12-28 weeks after given access to the grain. Mice and rats also are major causes of structural damage to houses and other buildings. Mice, in particular, are very destructive to rigid foam and other types of insulation in the walls of buildings.

Both mice and rats will eat virtually anything that is edible, but are strongly attracted to human dwellings because of the large source of food in the form of garbage. Both mice and rats can spread parasites and diseases, many of which are dangerous to humans. Most are aware that rats helped to spread the bubonic plague in Europe, one of the most destructive epidemics in human history. In fact, hungry rats sometimes will bite children and adults during sleep. For these reasons, you should never touch rats or mice. If you need to handle a mouse or rat (e.g., to remove one from a trap), or any other species of wildlife, you should always wear the appropriate protective clothing (e.g., leather or plastic gloves).

LEGAL STATUS

Utah state law does not protect house mice and Norway rats. They may be controlled using any pesticide registered by federal or state authorities for this purpose, or they may be controlled by use of mechanical methods such as traps.

CONTROL

Identification of Damage

When house mice and Norway rats live in or around structures, they almost always cause some damage. They commonly gnaw on materials inside the walls or floor. Evidence of this gnawing activity may be visible on doors, ledges, in corners, or on stored materials. Entry holes left in the walls or floors by mice are smaller in diameter than those of rats (1 ½ inches in diameter for mice, 2 inches or larger for rats). Mice and rats leave droppings along their runways, in feeding areas, and near shelter. Mouse droppings are usually about ¼ inch long, whereas those of rats typically are ¾ inch long. If mice or rats inhabit a building, it is common to hear them gnawing or running in walls and floors, particularly at night. Finally, visual sightings of mice and rats are common in areas they occupy.

Habitat Modification

Good sanitation is very effective in reducing mouse and rat populations in human dwellings. Unfortunately, even the best sanitation will not eliminate all mice and rats. However, it will make it easier to recognize mouse and rat sign (e.g., droppings, gnawing activity) and evaluate whether other controls should be implemented. Proper storage and handling of food materials, feed, and garbage is usually stressed as a method of rodent control. The removal of vegetation and debris around structures can discourage mice and rats from entering those dwellings. Placing a strip of gravel around dwellings also can prevent mice and rats from burrowing under the foundation and gaining access to the structure.

Exclusion

Physical barriers can prevent mice and rats from gaining access to structures where food and shelter is available. Rodent-proofing your dwelling is a permanent and effective means of control that can prevent much damage from occurring. Methods used to exclude mice and rats are similar, but you should be aware that mice can enter openings much smaller than those used by rats. Thus, if you are concerned about controlling mice, you should seal all openings larger than ¼ inch; if you are concerned only about rats, it is necessary to seal all openings larger than ½ inch. To seal openings to structures, you should use heavy materials that will resist gnawing. These materials include concrete mortar, galvanized sheet metal, and hardware cloth.

Repellents

Mice and rats find some chemical tastes and odors distasteful, but chemical repellents usually are not a practical method of controlling rodent damage. The agency responsible for regulating chemicals used on wildlife, the Environmental Protection Agency (EPA), currently approves of only one chemical for use in repelling house mice and Norway rats. Ro-pel® is registered by the EPA for deterring mice and rats from gnawing on trees, poles, fences, shrubs, and other objects. Unfortunately, little information is available on the

effectiveness of Ro-pel® in repelling mice and rats. As with most repellents, mice and rats may become accustomed quickly to the chemical and gnaw on objects even though the repellent has been applied.

Frightening devices

Mice and rats are wary animals and can be frightened by loud or unfamiliar sounds. However, they will quickly become accustomed to new sounds and thus tend to ignore them. Many devices that produce ultrasonic sound have been marketed as an effective and easy way to frighten mice and rats away from an area. Unfortunately, advertising claims made by companies that produce ultrasonic devices have not withstood scientific scrutiny. The studies that have been conducted discovered that mice and rats may be initially frightened by these devices, but usually return to the area and resume normal activities. Similarly, many devices which produce electromagnetic fields have been marketed as an effective rodent repellent. Again, however, scientific evidence clearly shows that these devices are not useful in repelling rats or mice. For these reasons, ultrasonic and electromagnetic devices are not recommended as a solution to rodent problems.

Toxicants

Toxicants are often used to control mice and rats in houses and other structures. Among the toxicants used for rodent control, anticoagulants are used most commonly. The first anticoagulants required that mice and rats feed on the bait multiple times to receive a lethal dose. Since then, single dose anticoagulants, such as brodifacoum and bromadiolone baits, have been developed and can be lethal after 1 feeding.

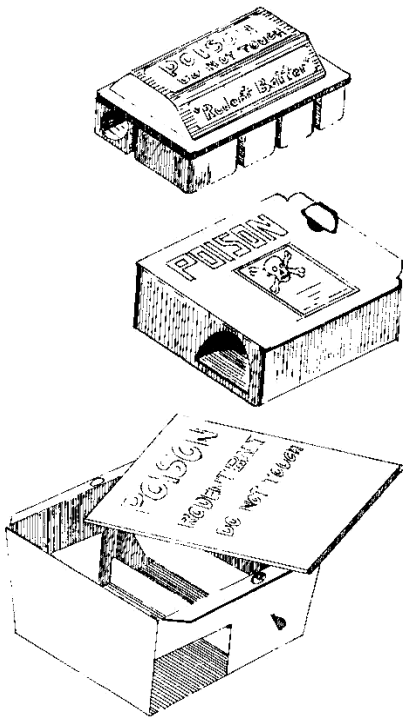

Figure 2. Examples of commercially manufactured rodent bait stations.

Although anticoagulants can be bought in concentrated forms and used to make your own baits, most homeowners prefer to purchase ready-to-use baits. These may come in paper packs that keep bait fresh and allow easy placement into burrows, walls, or other locations. Wax blocks have also been used for anticoagulant formulations and may be useful where moisture may cause the baits in paper packs to spoil. Finally, bait stations are often used and may increase the effectiveness and safety of rodenticides. Bait stations protect bait from moisture, keep other animals and children away from the bait, help prevent accidental spilling of bait, and allow easy inspection of the bait to is if mice or rats have been feeding on it. Again, some people construct their own bait stations, but most individuals prefer to buy pre-made bait stations (Figure 2). Most farm supply or hardware stores should have them in stock or can order them for you. Be sure you purchase a bait station made for the animal you want to control—bait stations made for mice are smaller than that for rats. Regardless of the formulation used to deliver the toxin, you should be aware that mice and rats can learn to identify and avoid toxic baits; this tendency is known as "bait shyness." However, you should be aware that mice and rats can learn to identify and avoid toxic baits; this tendency is known as "bait shyness." To avoid bait shyness, it may be necessary to prebait (offering rodents similar but nontoxic bait prior to applying the toxic bait) an area prior to using toxic baits. Before using anticoagulants in any form, you should be aware that death does not immediately follow ingestion of a lethal dose. Mice and rats that have ingested a lethal dose may die while in walls or floors and their decomposition can cause unpleasant odors.

Several non-anticoagulant baits are also used to control rodent populations. Of these, zinc phosphide baits are most common. Although zinc phosphide baits are effective in controlling mouse and rat populations, it is considered a restricted-use pesticide and can only be used by certified applicators. If you are interested in becoming acertified applicator, contact your local Utah State University county extension office.

As with all toxic chemicals, you should keep all rodenticides away from children and pets. For more information about these rodenticides, their uses, and how to obtain them, contact your local Utah State University extension office or any of the organizations listed at the end of this bulletin.

Trapping

Trapping is an effective and often used method of controlling mice and rats in human dwellings. Trapping offers a few advantages over the use of toxicants. Most importantly, trapping will allow you to witness your success in removing mice or rats and will allow you to physically remove the carcass, thereby eliminating odor problems that occur because of decomposition. Most often, trapping is done with the simple, wood-based snap traps found in hardware and other stores. Traps should be baited with a small piece of nutmeat, chocolate, dried fruit, or bacon. Peanut butter or marshmallows also are good baits. Although cheese is often used for bait, it

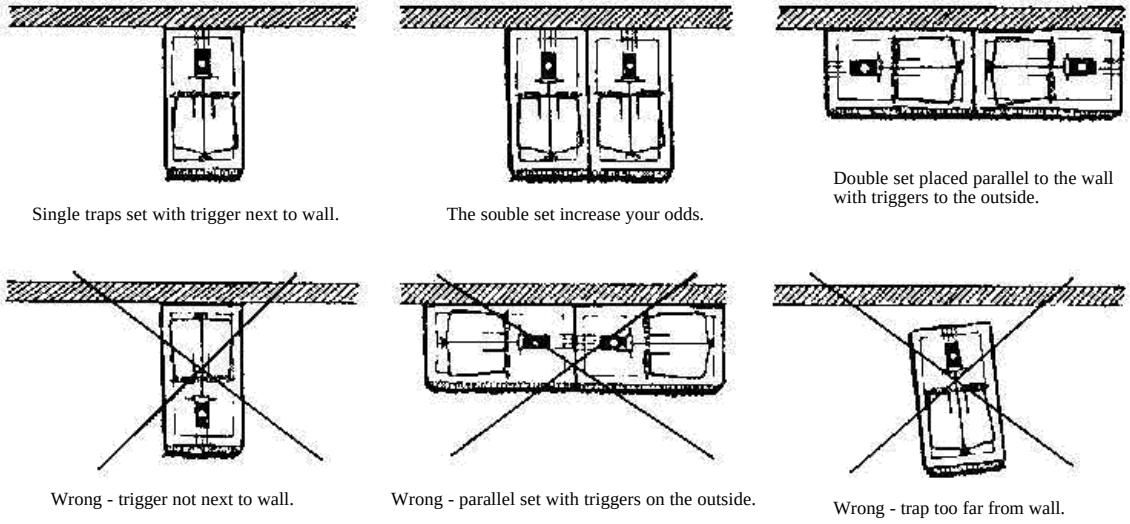

Figure 3. Examples of proper trap placement.

quickly become stale and losses its attractiveness. Traps should be set close to wall, behind objects, in dark areas, or in locations where mouse or rat activity has been observed. The traps should be set so that the mouse or rat will pass directly over the trap during their normal travel (Figure 3). Double traps can be used to increase the likelihood of capture. When removing rats or mice from traps, always wear protective gloves.

Other Methods

Fumigants (toxic gases) are sometimes used to control rats in their burrows at outdoor locations, but this is usually done to protect agricultural crops. Structural fumigation is also occasionally used to control rats and mice in dwellings or warehouses, but this can only be conducted by licensed pest control operators. In farm buildings or warehouses, shooting or clubbing can be an effective way to eliminate rats, but is not as effective for mice. Cats and dogs may kill some rodents, but typically are not useful in eliminating large populations of mice or rats.

ADDITIONAL SOURCES OF INFORMATION AND ASSISTANCE

For further information, contact:

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Salt Lake City, UT 84126
Phone – (801) 975-3307

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Hall, E.R. 1981. The mammals of North America. Volume 2, 2nd edition. John Wiley & Sons, New York.

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Wildlife Damage Management Series

Pocket Gophers

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Pocket gophers are medium-sized fossorial (burrowing) rodents, which have external fur-lined pouches located on the outside of their mouths. They use the pouches to carry food, hence the name "pocket" gopher. There are 35 species of pocket gophers in North and South America. Pocket gophers are sometimes confused with moles because of their similar burrowing activities. Moles, however, are smaller and lack cheek pouches.

Pocket gophers have yellowish-colored incisor teeth. These incisors are always exposed even when their mouth is closed (Figure 1). Pocket gophers vary in length from 6 to 13 inches. The color of their fur ranges from light brown to almost black. As with most fossorial mammals, pocket gophers have poor eye sight which is compensated by other well developed senses. They have short, hairless tails which are very sensitive and used to guide them when moving backwards in a tunnel.

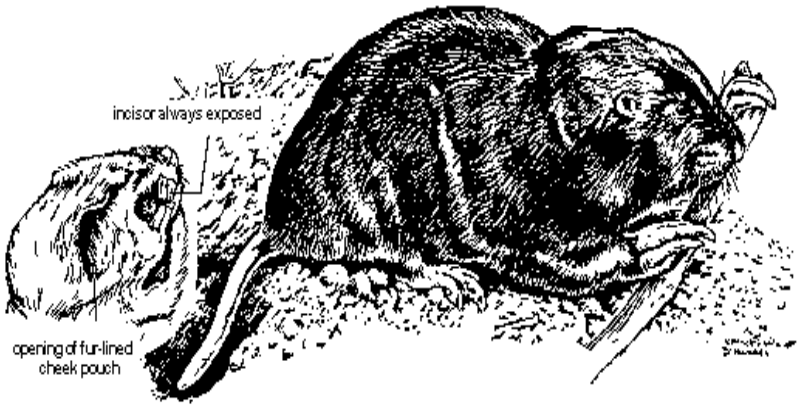

Figure 1. The pocket gopher.

They have large whiskers (vibrissae) which are sensitive to movement and can be used to guide their movements even in the darkest tunnels. Their forefeet are equipped with long claws.

Utah is inhabited by two species of pocket gophers, the Northern pocket gopher (Thomomys talpoides), and the Botta's pocket gopher (Thomomys bottae). The Northern pocket gopher is found in the northern part of Utah, where the Botta's is located from the central and southern parts of the state.

BIOLOGY AND BEHAVIOR

Pocket gophers are best identified by their external cheek pouches and the soil mounds they leave behind as evidence of their tunneling or burrowing activities. Mounds are fan-shaped and the entrance is sealed by a soil plug. The mounds are created when the gophers move excavated soil to the surface when tunneling.

Pocket gophers use their long powerful claws and teeth for digging their burrows. As with all rodents, their incisors grow continuously and require constant gnawing or filing to keep them at a manageable length. Soil, rocks, and other items loosened by digging are moved away with their hind feet, then bushed to the surface with their chest and forefeet.

Burrow systems consist of a main tunnel from 4 to 18 inches below the surface with a number of lateral tunnels branching off from the main tunnel (Figure 2). Lateral tunnels end at the surface where the soil mound is created. Pocket gophers usually construct one nest and a number of food cache chambers in

deeper tunnels which branch off from the main tunnel. A nest chamber also is lined with vegetation. Nest chambers and food caches have been found as deep as 5 to 6 feet below the surface. Tunnel widths vary according to the size of the pocket gopher, but most average about 3 inches in diameter.

A burrow system is typically multi-branched. During the breeding season a male's burrow may be more linear since its sole purpose is to intercept a female's burrow. A single pocket gopher may construct as many as 300 soil mounds in a year while moving over 4 tons of soil. Burrows are continually changing, with old tunnels being sealed off and new ones excavated. A single tunnel system may consist of as much as 200 yards of tunnels. Generally, the poorer the habitat the longer the tunnels must be to meet food needs. Pocket gophers are highly territorial and will vigorously defend their tunnels from intruders. There is typically one pocket gopher per tunnel system, unless the female has a litter or it is the mating season.

Pocket gophers are active all year long. When snow is present they will tunnel in the snow. Soil from below ground burrowing is pushed up under the snow. When the snow melts,

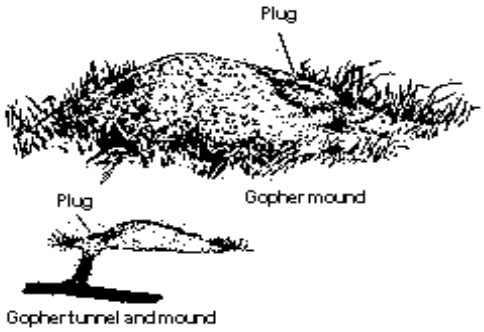

Figure 2. Pocket gopher mound and its relation to tunnel.

the soil casts (tubes) that are left behind provide evidence of their winter burrowing activities.

Pocket gophers reach sexual maturity the following spring after they were born. Females generally have only one litter a year. Litters are born from March to June. In warmer climates females may have 2 or more litters. Each litter may consist of 1 to 13 young with 3 or 4 being average. Gestation is typically 18 or 19 days with 51 days being the maximum reported.

Pocket gophers eat only plant materials such as forbs, grasses, shrubs and trees (herbivores). They eat roots that are exposed by their tunneling as well as above ground vegetation. Alfalfa and dandelions roots are preferred foods for pocket gophers.

LEGAL STATUS

Pocket gophers are not protected by federal or Utah state law. As such, they can be controlled when causing damage.

CONTROL

IDENTIFICATION OF DAMAGE

Because pocket gophers spend most of their time under ground, the best way to identify their presence is fresh soil mounds. Pocket gophers have been responsible for damage to underground utility cables and irrigation pipes, direct consumption and destruction of plants with their soil mounds, and changes in plant species composition when the soil mounds create an opportunity for weed seeds to germinate. Trees are damaged by gophers when stems are girdled and clipped, roots are pruned, and roots become exposed due to tunneling. Gopher mounds damage mowing equipment. Also, soil brought to the surface is easily eroded. Tunnels in irrigated fields can divert water causing a loss irrigation water. Tunnels in earth banks and dams can cause these structures to weaken resulting in water loss due to seepage or the complete loss of the structure. Badgers burrowing activities as they pursue pocket gophers can also increase causing even more damage if densities are high.

A survey of Utah alfalfa growers concluded that about 83% of alfalfa producers experience pocket gopher damage to their crop. Thus, pocket gophers may have the greatest economic impact on Utah alfalfa producers. Pocket gophers damage alfalfa hay by eating the plant's tap roots and then soil mounds will reduce plant vigor when other plants are buried.

POCKET GOPHER DAMAGE IN URBAN AREAS

Although pocket gophers can cause significant damage on Utah farms and ranches, they also can cause damage to lawns and gardens in urban areas. Frequently, this damage is greatest in new subdivisions or other areas where undeveloped tracts of land dominated by weeds occur.

EXCLUSION

Exclusion of pocket gophers can be very costly and is usually impractical for most farms and ranches where populations are high. However, barriers can be used effectively to valuable ornamental trees and shrubs around homes, gardens, and nurseries. A mesh (1/4-1/2 inch) fence, buried about 18 inches can be effective at protecting gardens, flower gardens, and plant nurseries. Plastic cylindrical netting placed over the entire seedling can be used to help reduce damage to newly planted trees and shrubs.

HABITAT MODIFICATION

Habitat modification techniques use knowledge of pocket gopher habits and feeding behavior to reduce or eliminate damage. The techniques include the use of resistant crop varieties, crop rotation, flood irrigation, and cultivated buffer strips in urban and rural areas.

Crop Varieties

Alfalfa plants with a single tap root are more prone to reduced vigor due to gopher damage than alfalfa with several tap roots. Also, gophers in alfalfa fields with fibrous roots have smaller home ranges and therefore gopher impact may be reduced in these areas.

Crop Rotation

Rotating an alfalfa crop with a grain crop will significantly alter pocket gopher habitat. The root systems of grains do not produce sufficient food supplies for gophers making it impossible for them to survive year round.

Flood Irrigation

The use of flood irrigation can reduce suitable gopher habitat. Water will fill their tunnels drowning the rodent or forcing them to the surface, thus increasing predation on displaced gophers. Leveling any high areas in a field will increase the effectiveness of flood irrigation by eliminating any potential refuges.

Buffer-Strips

Cultivating and planting a 50 foot buffer-strip of grains are grass around alfalfa fields and in urban and rural areas may create unsuitable habitats for gophers. This buffer strips can reduce damage lawns, gardens, plant nurseries, and high-value crops since the shallow rooted grains and grasses provide little food for foraging pocket gophers. In addition, periodic deep cultivation will destroy or expose existing or new tunnel systems.

REPELLENTS

No repellents have proven effective for controlling pocket gophers. Sonic or electromagnetic devices sold commercially also have not proven to be effective.

TRAPPING

Trapping can be extremely effective on a small scale to remove any pocket gophers that remain after a control program, eliminate new infestations, reduce pocket gopher populations to acceptable levels, or eliminate pocket gophers from lawns and gardens in urban and rural areas. Pocket gophers are best trapped during spring or fall when they are most active. For trapping to be the most effective the main tunnel of an active burrow system needs to be located. Active tunnels can be found by locating a freshly-made soil mound. A metal probe or a shovel can be used to probe the fan-shaped plug side of the mound to locate the main tunnel. Trapping in the main tunnel system is more successful then setting traps in the lateral tunnels. One trap should be placed into each end of the tunnel to catch the gopher coming from either direction (Figure 3). Trapping success may be enhanced by leaving the hole open to let in sun light to attract the gopher. Others have better success by covering the excavated hole with plywood or other suitable material. Traps should be secured by wire or chain to reduce the chance of predators taking them away or a pocket gopher carrying them into the tunnel. A small flag can be placed near the trap site to help relocate the traps. If the traps have not been visited within a 48 hour period then move the traps to a new location. After an animal is caught the traps can be removed and reset at another fresh soil mound.

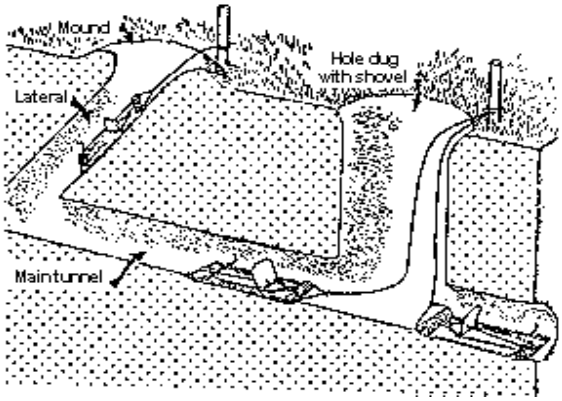

Figure 3. Trap placement in lateral or main pocket gopher tunnels. Note that traps are staked.

TOXICANTS

Several rodenticides for controlling pocket gophers have been registered with the federal government and are in current use. Strychnine alkaloid (0.25 to 0.5% active ingredient) and zinc phosphide (2%) on grain baits or pellets are registered for controlling pocket gopher damage. Both toxicants are restricted-use pesticides, and can only be used by certified applicators. (Contact your local Utah State University county extension agent for certification requirements.)

Strychnine is only registered for below ground use. Most gophers will be killed within the first week after bait application. When using strychnine, closely follow label instructions. Be sure that any spilled or unused bait is removed from the treatment site and stored according to label instructions. Wet and damp ground causes the bait to decompose rapidly. Thus, more bait may need to be applied after a rain storm or irrigating.

Anticoagulant baits (Chlorophacinone and Diphacinone) are also registered for pocket gopher control. These are the same chemicals used in common rodent poisons. Diphacinone comes in a paraffin block that will last longer than grain bait and will also poison any new gophers which come into the burrow system.

Hand Baiting

A common method used to apply pocket gopher bait is hand-baiting. This method is time consuming, therefore it is only practical for small areas or new infestations. Once an active burrow system has been identified by presence of fresh soil mounds, the applicator can either use a shovel or a specially made hand bait-dispenser or probe to locate a tunnel. When the tunnel has been located, a tablespoon of bait is placed into the tunnel far enough so that it will not be covered when the hole is sealed (Figure 4). For best results, bait every burrow system in two or three locations. The hand baiting method can be used in any soil condition.

Mechanical Burrow Builder

The burrow builder system is a tractor-drawn machine which excavates gopher sized tunnels and at the same time dispenses the bait at set intervals (Figure 5). When a gopher discovers a new tunnel system it will investigate, find the bait, and take it to its own burrow to be stored and eaten later.

The burrow builder is very effective for use on large areas When using a burrow builder, it is recommended that the burrows be excavated to depths determined from active gopher tunnels and artificial burrows placed 20-25 feet apart. In most

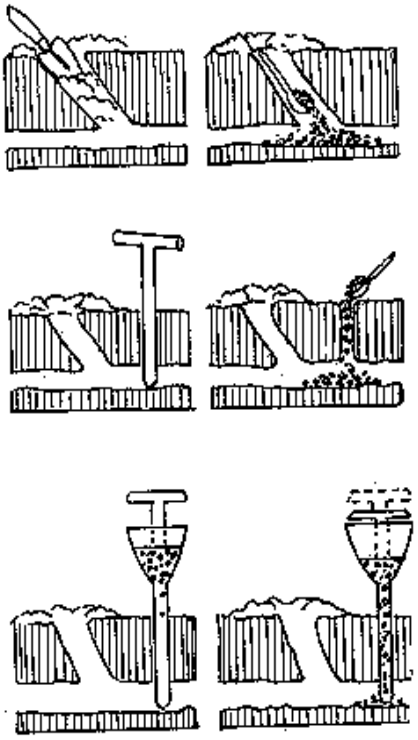

Figure 4. Methods of applying gopher bait by hand or with a probe.

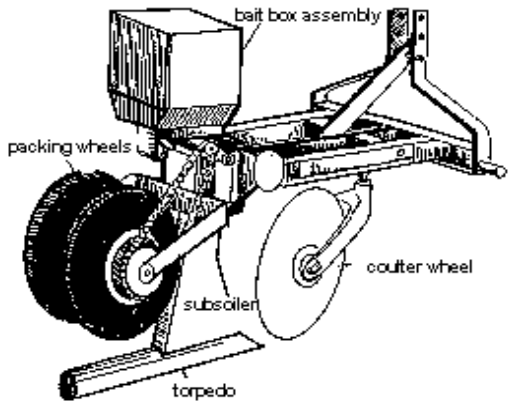

Figure 5. The "burrow-builder" machine may be used to control pocket gophers on large acreages.

cases an artificial burrow depth of 9-10 inches is desirable. Soil conditions should also be considered when using the burrow builder. If the soil is too wet or too dry the machine will not be effective.

To determine if soil conditions are suitable for using a burrow builder, pick up a teaspoon of soil and roll it into a ball. If the ball holds its shape, the soil is suitable for using a burrow builder. Burrow builders can be used to form a burrow around the edge of treated fields to deter any immigrating gophers. (Plans for building a burrow-builder can be found on pages 4 and 5 of this bulletin).

FUMIGANTS

Federally approved fumigants include aluminum phosphide and gas cartridges. Aluminum phosphide is a restricted use chemical and can only be used by certified applicators. Fumigants are usually not very effective at reducing gopher damage as toxicants or trapping, because the gases move too slowly through the burrow system. This may allow pocket gophers to seal fumigant-treated tunnels before being overcome by the gas. Fumigants are best used in damp soil because the gas will diffuse through dry soil.

FOR FURTHER INFORMATION, CONTACT:

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Additional Reading

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POCKET GOPHER MANAGEMENT SUPPLIES

TOXICANTS

Anticoagulants (Chlorophacinone and Diphacinone)

B & G Chemicals and Equipment Co., Inc.
10539 Maybank
Dallas TX 75345-0428
(214) 357-5741
(800) 345-9387
(214) 357-4541 Fax

J. T. Eaton & Co., Inc.
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Twinsburg, OH 44087
(216) 425-7801
(800) 321-3421
(216) 425-8353 Fax

HACCO, Inc.
Box 7190
Madison, WI 53707
(608) 221-6200
(608) 221-6208 Fax

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(800) 345-9387
(214) 357-4541 Fax

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Reviewed December 2010

Wildlife Damage Management Series

Raccoons

Corey M. Huxoll, Terry A. Messmer* and *Mike Conover

Quinney Professorship for Wildlife Conflict Management
Utah State University Extension Service and College of Natural Resources
Department of Fisheries and Wildlife
Jack H. Berryman Institute
Utah State University, Logan, Utah

USU Extension in cooperation with:

CNR—Quinney Professorship for Wildlife Conflict Management
Jack H. Berryman Institute
Utah Division of Wildlife Resources
Utah Department of Agriculture and Food
USDA/APHIS Animal Damage Control

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Raccoons (*Procyon lotor*) are found across the United States largely due to their excellent ability to adapt and take advantage of new habitats. Raccoons, although not native to Utah, are abundant throughout much of the state. They are most commonly found in wooded areas along rivers, marshes or lakes. In urban areas, raccoons will make dens in attics, chimneys, under houses, in abandoned buildings, and in woodpiles.

Raccoons, like most animals, are opportunistic and seek a lifestyle that has the greatest reward for the least effort. Urban environments often present such opportunities and raccoons have been quick to adapt. Extension and resource agency professionals estimate that raccoons cause 60–70% of all urban wildlife problems in Utah.

Raccoons are a grizzled gray in color and are easily distinguished by their bushy tails with alternative black or gray rings, and black mask across their faces. The print of the hind foot faintly resembles that of a small child (Figure 1).

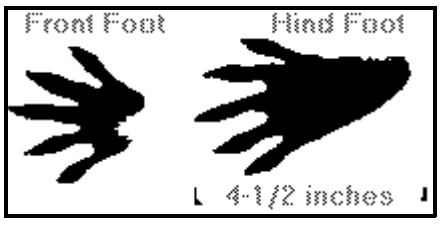

Figure 1. Raccoon paw prints

RACCOON PROBLEMS

Most towns and cities in Utah have raccoons living within city limits. Because raccoons are active by night (nocturnal), they are seldom seen. Of all the wild animals that have adapted to city life, raccoons are probably the most destructive.

Raccoons cause problems when they lose their fear of humans and move into urban areas to live. Problems include feeding in garbage cans, establishing dens in chimneys and plugging them with nest material, tearing off shingles or fascia boards to enter an attic or wall space, or causing damage to gardens and fruit trees. Raccoons also may carry fleas, ticks, lice, distemper, mange, rabies, and canine and feline parovirus. The results of recent blood tests conducted on raccoons in Utah indicated that over 80% of those tested had been exposed to rabies as indicated by the presence of a rabies titer.

Raccoon feces may also contain the roundworm egg (*Baylisacaris procyonis*). Humans, especially children, that come into contact with raccoon feces containing eggs of this roundworm can also become infected. Clinical symptoms depend on the number of roundworm larvae present in the body and their location. If the larvae migrate to the eyes or brain, blindness or death can be the end result.

Raccoons can also threaten the health of other mammals. They can carry Aleutians disease which is a virus that affects other fur-bearing animals. As such, it poses a major threat to Utah's fur industry. In addition, raccoons entering the buildings where mink are raised may eat off the mink's feet

through the wire mesh in the bottom of their cages. The injured mink usually die soon after the injury.

Raccoons also cause problems in rural areas by raiding chicken coops or poultry farms and killing many birds, only consuming a portion of the total number killed. Damage to agricultural grain crops and raccoon predation on bird nests are other common problems.

BIOLOGY AND BEHAVIOR

Adult raccoons in Utah may weigh from 10 to 30 pounds, are 2 to 3 feet in length, and are about 16 inches tall at the shoulder. Adult males may occupy territories of 3 to 20 square miles, compared to 1 to 6 square miles for females.

Raccoons do not hibernate during the winter, but may sleep several days to a couple of weeks during extreme cold periods. They are nocturnal and solitary except when breeding or caring for their young.

Breeding usually occurs from January to March, with females mating only once a year. Usually less than half of yearling females will breed, while adult females normally breed every year.

After a gestation period of about 63 days, an average litter of 3 to 5 young are born usually in April or May. The young weigh about 2 ounces at birth, open their eyes at about 3 weeks, and are weaned from 2 to 4 months of age around late summer. Some young may disperse in late autumn, but all are driven away by the female before her next litter is born.

A female with young may attack if cornered, so caution should be taken if a mother and young are encountered in an attic or other enclosed space. Pet raccoons may also attack humans. Hence raccoons should not be kept as pets, especially if there are small children in the house who could not defend themselves if attacked.

Raccoons generally have a short life span. Fifty to seventy percent of all populations consist of raccoons under one year old. Raccoons rarely live to the age of 12 years in the wild.

Raccoons are omnivorous and will eat either plants or animals, depending on what is available. Plant foods may include fruit, vegetables (especially sweet corn) or nuts. Animal foods may include grubs, crickets, grasshoppers, large insects, crayfish, clams, frogs, worms, fish, turtles, bird eggs and nestlings, and small mammals such as squirrels, rats, or mice. In urban areas, raccoons may feed on dog or cat food, fruit on trees, garden vegetables, or trash can garbage.

LEGAL STATUS

Raccoons are not protected under state law in Utah. As such no hunting or trapping license is required to take this animal. Utah state law prohibits possessing a live raccoon without a permit. Possession permits may be issued through the Utah Department of Agriculture if appropriate justification is provided.

CONTROL

IDENTIFICATION OF DAMAGE

The first step in controlling any urban wildlife problem is to determine which animal(s) are causing the damage. Evidence of raccoon activity may include tipping over trash cans and scattering trash, tearing up shingles or fascia boards to enter an attic or wall space, or plugging chimneys with nest material. Raccoons in a chimney or attic may "whine," "growl," or make noises that indicate their presence.

Raccoons may damage gardens or fruit trees, as evidenced by remains of partially eaten fruit under or still on the tree. Raccoons usually pull over cornstalks or pull down ears, then partially husk the ears prior to eating the corn off the cob. They damage melons by digging a small hole and hollowing out the contents. Raccoons may also kill chickens or other poultry or damage commercial farm crops in rural areas.

Raccoon activity may be identified by the presence of distinctive tracks around the damage site (Figure 1). The hindprint is 3¼ to 4½ inches long, much longer than wide, and the foreprint is shorter, about 3 inches long, and about as wide as long. The average distance between prints of a walking raccoon is 14 inches, with the left hindfoot almost beside the right forefoot. Five toes and claws are visible on all feet. Skunk tracks are smaller, with the hindprint being 1¼ to 2 inches long, and the foreprint 1 to 1¾ inches long. Flour may be spread at damage sites to reveal tracks from night activity.

Once it has been determined that a raccoon is causing the problem several measures can be taken to alleviate the damage. These measures may include habitat modification, exclusion, the use of chemical repellents, and population reduction.

HABITAT MODIFICATION

Raccoon problems may be alleviated by making the habitat, or area around the site, less favorable to raccoons. Because raccoons have fairly large territories, a neighborhood or community-wide effort may be more successful at alleviating the problems. Removing potential sources of food, water, and shelter is the first step in eliminating the problem. This would include removing pet food and water during the night or keeping the yard clean and woodpiles tacked neatly. Garbage cans should also be tied down to a solid structure so they cannot be overturned, and lids should be tight fitting, tied down, or weighted down to deny access to garbage.

EXCLUSION

Excluding raccoons may be the most successful strategy to prevent or eliminate raccoon damage to buildings, poultry yards, milk barns, and gardens.

! Damage to fascia boards or shingles may be prevented by eliminating access routes to the roof. The removal of tree limbs overhanging the roof will deny raccoons access to roofs.

- Access to chimneys may be denied by covering the chimney opening with a heavy metal screen or with a sheet metal cap.
- Damage in poultry yards can usually be reduced by excluding the raccoons from the poultry during the night. This may be done by moving the poultry into buildings at night and tightly closing all doors, windows, and sealing any openings larger than 3 inches in diameter.
- Woven wire fencing alone may not be sufficient to keep raccoons out of gardens or poultry pens. Raccoons will either climb, tear a hole, or burrow under most fencing. If a fence is already present, the addition of a single wire about 8 inches form the fence and 8 inches above the ground electrified with a charger will provide an effective deterrent. Use a charger with a seal of approval from Underwriters Laboratories Inc. (UL), and do not use it where children or the public might come into contact with it. After you have decided to use an electric fence be sure to attach the appropriate warning signs.

  When no other fences are present, two electrified wires, one 6 inches and the other 12 inches above ground, mounted on insulated stakes or poles, will accomplish the same results (Figure 2). A single strand from 6 to 8 inches about the ground may be sufficient, but two wires will provide added insurance. The fence only needs to be "on" at night.
- A woven wire mesh fencing may be effective at keeping out raccoons. However, the fence should be 6 feet high, with the top foot bent outward from the protected area to discourage raccoons from climbing over. Adding an electrified wire to the top of the fence will increase effectiveness. To prevent raccoons from burrowing underneath a fence, a 2 foot wire mesh may be buried to a depth of 6 inches and the remaining 18 inches buried outward at that depth.

CHEMICAL REPELLENTS

A variety of materials, including dog or predator feces, blood meal, dirty laundry (human scent), and mothballs have been tested to repel raccoons; however, none have been proven to be effective. Research suggests that mothballs (napthalene) or PDB crystals (paradichlorobenzene) may be effective repelling mammals from enclosed spaces such as chimneys, attics, wall spaces, or crawl spaces. Use of these chemicals may encourage raccoons to leave the area so that other exclusion techniques may be implemented.

BEHAVIORAL APPROACHES

The use of scare tactics or devices, such as propane cannons that make loud "booms," pyrotechnics (fireworks), scarecrows, lights, or dogs are not effective or practical in an urban area. Raccoons usually figure out that scare tactics pose no physical threat and ignore them.

POPULATION MEASURES

If no other control methods are effective, the problem animals may need to be removed from the area. There are no poisons or fumigants currently registered for raccoon control. Trapping can be effective at removing the problem animals. Leghold (steel-jaw) traps or Coni-bear (body-gripping) traps may be used on rural sites, but should never be used in an urban area because they are non-selecting and there is a risk that a neighbor's cat, dog, or child might be injured. In addition, some city ordinances may further restrict the use of leghold or Conibear in urban areas.

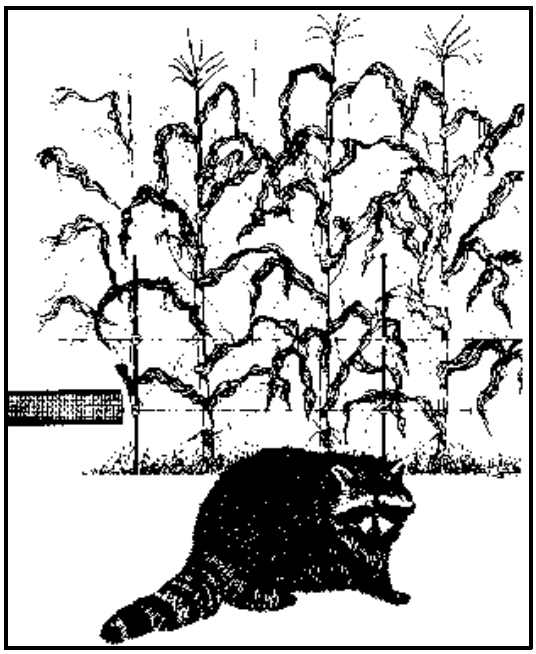

Figure 2. Adding a two-wire fence will help keep raccoons out of field or garden crops. Inset shows the "ribbon-type" electric fence in place of the single-wire type. This ribbon fence is more visible to raccoons and other wildlife and may improve control.

Cage-type live traps that are at least 10 inches wide by 12 inches high by 32 inches long and constructed with heavy materials are the best way to capture problem raccoons in urban settings. The traps may be baited with sardines, fish, meat, or fruit. Baiting with peanut butter on bread or fruit, vanilla extract on bread, or just fruit in an urban area should decrease the likelihood of catching a cat. The trap should be placed on a sheet of plywood or other hard surface, as raccoons will dig up all the grass or anything in reach after being trapped. Place the trap so that the back is against a tree, wall, or other solid object. Lastly, the trap may have to be covered in burlap or a tight wire mesh to prevent animals from reaching through and stealing the bait.

Many homeowners prefer to release raccoons unharmed in a distant location "where the animal can find a good home."

Studies have shown that relocated raccoons tend to create problems in new areas. There is growing opposition to relocating animals because of the possibility of disease spreading from one population (an urban one) to another (a rural one). In addition, research indicates that a relocated raccoon may be forced out of the new area by the other raccoons already present. As such it may not have a good change of survival. Local private pest control companies, humane society or animal shelter may be willing to dispose of the raccoon for you.

Leghold or Conibear traps may be effective at controlling problem raccoons in rural areas. A No. 1½ to 2 coil-spring trap is suggested for raccoons. Conibear traps will usually kill the trapped animal instantly. Trapping with leghold or Conibear traps is complicated and should not be attempted without proper instruction. There is a good chance that stray cats, dogs, or other wildlife will get caught and injured if the trap is placed incorrectly.

Shooting any animal with a firearm within city limits is illegal in Utah. However, in rural areas, shooting a problem raccoon may be effective at preventing further damage.

FOR FURTHER INFORMATION, CONTACT:

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Extension Wildlife Specialist
Department of Fisheries and Wildlife
Utah State University
Logan UT 84322-5210
(435-797-3975)

Utah Division of Wildlife Resources
1596 West North Temple
Salt Lake City UT 84116-3154
(801-538-4700)

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Raccoon line drawings by Charles Schwarz, Missouri Department of Conservation.

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Reviewed December 2010

SKUNKS

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Wildlife Damage Management Series

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Skunks are among the most widely distributed mammals in North America. The striped skunk (*Mephitis mephitis*) is found throughout the United States and parts of Canada, while the spotted skunk (*Spilogale gracilis*) occurs mainly in the United States. Both species are found in Utah.

Skunks are readily recognized by their black and white pelage pattern and their unique, odorous musk which they use for defense against predators. Skunks are omnivores and feed on a wide variety of plant and animal material. Their diet includes berries, fruits, vegetables, insects, small rodents, reptiles, eggs, and young birds.

The striped skunk has short, stocky legs and is about the size of a house cat. They have two broad white stripes running the length of their jet black body from the ape of the neck to the base of the tail. A single white stripe separates the eyes and the long bushy tail is tipped in white (Figure 1). Adult striped skunks can weigh up to 10 pounds. Adult spotted skunks weigh from 2 to 4 pounds. Their smaller size and the presence of white spots and short, broken white stripes on a black body can be used to distinguish this species.

SKUNK PROBLEMS

Skunks are highly adaptable. They frequently live in close association with humans. Although skunks are commonly considered a nuisance, their tendency to consume insects and rodents harmful to agriculture crops may benefit farmers. Unfortunately, these same activities can also create additional damage situations.

Skunks eat the eggs and young of ground nesting birds. Skunks may also damage vegetable gardens, kill and eat domestic poultry and their eggs. Occasionally they may damage beehives while trying to feed on the bees.

Skunks disrupt unsecured garbage cans and consume pet food that is left outdoors. They may also damage lawns, athletic fields, and golf courses by digging up turf as they search for food.

Figure 1. A striped skunk in a defense stance, and ready to spray.

Skunk denning activities can also result in damage. Dens located under buildings can be a nuisance to building occupants should the skunk release its musk.

Lastly, skunks can also be a major disease factor. In many states skunks are the primary wildlife carrier of rabies. They may also be infected with tularemia, distemper, Aleutians disease and several parasites including fleas, lice, mites, ticks, roundworms, tapeworms, and flatworms.

BIOLOGY AND BEHAVIOR

Skunks mate in late February to early March,. Average gestation period is 62 to 66 days. Skunk kits are born from early May to early June. Litter sizes can range from 2 to 10.

Kits are born blind and thinly furred. Their eyes open in 17 to 21 days, and by 2 to 4 weeks of age, the kits are available to expel musk from their glands. They begin to hunt with their mother at about 2 months of age. Until then, they are left alone in the den when the mother goes out hunting. The kits remain with their mother until autumn.

Skunks are solitary animals. They come together only during the breeding season and during winter when several may be found denning together. Although skunks do not hibernate, they may become inactive for extended periods during the winter.

Skunks have poor to fair senses of hearing and smelling. They also tend to be somewhat clumsy runners due to their short, stocky front legs.

Skunks are characterized as being shy, secretive animals. They discharge their scent when disturbed, cornered, or harassed. Prior to releasing scent, the skunk often will stamp its forefeet rapidly while lifting its plume over its back,

If you are confronted by a skunk and this behavior is noticed, retreat slowly from the area and avoid making any loud noises or aggressive motions. A skunk has the ability to direct the musk to either side, in back of, or in front of its body, by alternating the direction of the protractile glands. The fluid may be expelled a distance of 8 to 15 feet, with a mist going even farther.

Skunks are primarily nocturnal, but may at times be seen in early morning or late afternoon while searching for food. Their normal home range is from ½ to 1 ½ square miles. During the breeding period, males may wander 4 to 5 miles a night.

A skunk’s diet varies greatly throughout the year. During spring, skunks may feed on mice, eggs, snakes, insect grubs and larvae. Small areas of up-turned earth may be evidence that a skunk has been digging for insects or grubs. In summer, skunks will feed mainly on grasshoppers, crickets, beetles and other insects. Fruits and berries, while in season, are also a valuable food for the skunk. During winter, they occasionally eat voles, shrews, mice, cottontail rabbits, chipmunks and other small mammals.

LEGAL STATUS

Striped skunks may be killed in Utah anytime without a license, using legal methods. Spotted skunks may be killed without a license when they are creating a nuisance or causing damage. However, their skins or glands may not be sold or traded unless a Utah furbearer license is possessed. Trapping and shooting restrictions also may apply within city limits, around livestock and other structures. Be sure to check restrictions in your county before taking action. Utah state law prohibits possessing five skunks without a permit. Possession permits may be issued by the Division of Wildlife Resources if appropriate justification is provided.

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CONTROL

IDENTIFICATION OF DAMAGE

Skunk damage to turf can be identified by small 3- to 4 inch cone-shaped holes in the ground or by small patches of exposed earth. Turf damage may be reduced by using an insecticide to eliminate grub populations. Use those insecticides which are rated as having low toxicity to wildlife.

Skunks usually will not climb fences. Therefore, poultry killed within a fenced area were probably not the result of a skunk, unless skunks have gained access by digging under the fence or through an opening in the fence. In such cases skunks will normally just feed on the eggs and may kill one or two birds. Skunk-damaged eggs typically will be opened only on one end and crushed inward. If multiple birds are killed or mutilated, that may indicate dog, raccoon, mink, or weasel activity.

HABITAT MODIFICATION

Brush piles, open irrigation pipes, and junk cars offer shelter to skunks. The presence of these human-altered habitats may encourage use of an area by skunks. Grain storage areas, barns, sheds and garbage which provide food sources may also attract skunks. Eliminating potential den sites and food sources from an area is an essential step in long-term reduction of skunk numbers.

EXCLUSION

Skunks can be excluded from denning under buildings that lack concrete basements or foundations by sealing all holes with fine wire mesh. A 2-foot wire mesh with the bottom 6 inches bent out at a 90 degree angle and buried at a depth of 6 inches will prevent skunks from digging underneath buildings.

Skunks that become established under buildings have been removed by using chemical repellents, trapping and exclusion techniques. Some vertebrate pest control officials have had success repelling skunks from under buildings by placing mothballs, naphthalene flakes, or paradichlorobenzene crystals in the areas being used as den sites. Rags soaked with cleaning solutions of bleach or ammonia have also been reported to be effective repellents.

To determine if a skunk is still using an area, seal all possible openings except for the maintenance. Flour, or some similar material that will record tracks, should then be spread out on the ground in front of the main entrance. After dark, examine the site for tracks (Figure 2).

If tracks are present and they indicate that the skunk has exited, immediately close the opening. If no tracks are present, return in an hour to re-examine the site. If there are still no tracks, continue to observe the site for several days. If no tracks are observed over this time period the entrance can be sealed.

Chicken coops or poultry houses may be skunk-proofed by sealing all non-essential building openings. Four to six foot widths of wire mesh fencing may be used to fence poultry yards. The bottom 6 inches of fencing should be bent outward at a 90 degree angle and buried to a depth of 6 inches to discourage skunks from digging under the fence.

Damage to beehives can be prevented by placing the hives on stands at least 3 feet high. Aluminum guards placed around the bottom of supports will keep skunks from climbing up to the hives.

If a skunk is found trapped in a window well, a rough board or 4 inch diameter log slowly placed into the well will allow the skunk to

Figure 2. Striped skunk tracks.

climb out. To prevent such incidents from reoccurring, window wells should be covered with wire mesh or plexiglass coverings that have been designed specifically to cover such openings.

Skunks may enter farm buildings, garages, or other structures. If this occurs exits and entrances should be left open to allow the animal to leave on its own. Harassing or disturbing cornered skunks may result in them releasing their scent.

If a skunk should spray, the odor can be neutralized using a solution containing neutroleum alpha. Contaminated clothing can be soaked in a diluted solution of household ammonia or bleach. **(Remember to never mix bleach with ammonia.)** Tomato juice, vinegar, or a number of pet deodorizers can also be used.

Skunk scent sprayed in the eyes can cause temporary blindness. Eyes should be flushed thoroughly with water if this occurs.

CHEMICAL REPELLENTS

Currently there are no chemical repellents registered for use on skunks in Utah. Mothballs and ammonia have been used to repel skunks. However, these chemicals must be used in large quantities and replaced often to be effective. In general, repellents afford only temporary solutions.

BEHAVIORAL APPROACHES

Scare techniques or devices have not been shown to be effective in repelling skunks.

POPULATION MEASURES

When skunk damage becomes intolerable, there are several options available to remove the offending animal. These include the use of live, leghold, and coni-bear traps, or shooting.

Livetraps can be set at den entrances or areas frequented by skunks (Figure 3). The use of covered or concealed livetraps will reduce the chance of the skunk spraying its scent upon capture. The trap can be baited with cat food, bread and peanut butter, sardines, eggs or food scraps. Once the skunk is caught, a canvas or plastic tarp can be placed over the trap during transportation. Your local animal shelter or a licensed pest control business may be willing to dispose of the skunk for you.

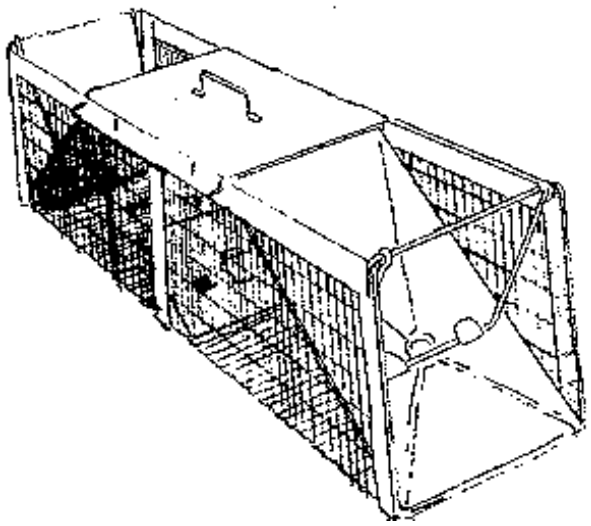


Figure 3. A live trap.

Releasing a trapped skunk into another area is not recommended, due to the potential for transmitting diseases to wild skunk populations. In addition, a problem skunk from one area is likely to become a problem skunk in the release area.

No. 1, 1 ½ and 2 size leghold traps are very effective for trapping skunks. Since skunks are not trap shy, bedding the trap in the soil is not necessary. The dirt-hole or cubby-sets work well for trapping skunks.

The traps should not be staked solid but anchored by a 20 to 30-foot chain or heavy 9 gauge wire. Once the skunk is trapped it should be approached cautiously. The end of the wire or chain should be picked up and the skunk slowly led to a place where it can be disposed of.

Coni-bear traps are kill-type traps which will dispatch a skunk instantly, sometimes, without musk release. A No.#220 coni-bear trap in a bait box set has been used with good success (Figure 4).

Leghold and coni-bear traps are not recommended for use by non-professionals in residential areas because of risks they pose to domestic pets and children. However, in the hands of a professional, these traps can be highly selective. He sure to check local restrictions before considering the use of any of these control measures.

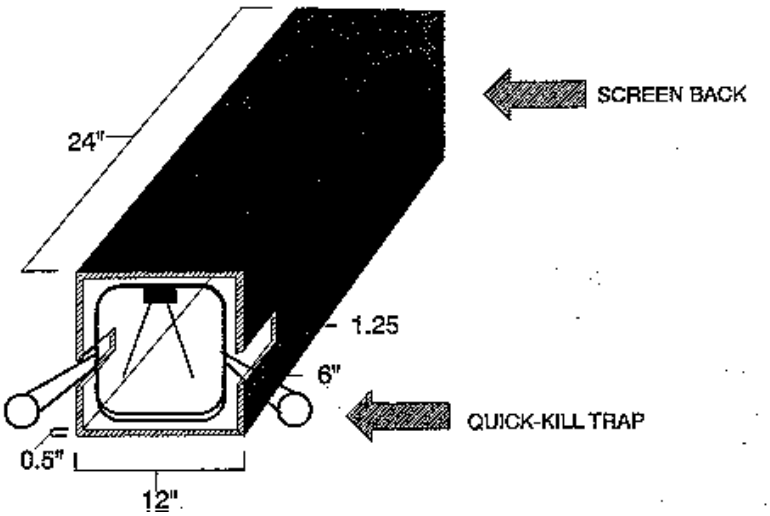


Figure 4. A coni-bear trap in a bait box set can be used to trap skunks. Bait should be placed in the back of the box. The box should be placed in an area that is frequented by skunks.

TOXICANTS

There are no toxicants currently registered in Utah for controlling skunks.

FUMIGANTS

There are no fumigants currently registered in Utah for controlling skunks.

ADDITIONAL SOURCES OF INFORMATION

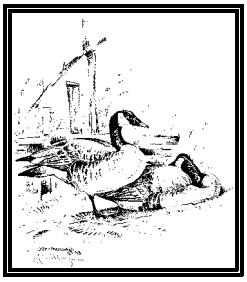
Utah Division of Wildlife Resources
1596 West North Temple
Salt Lake City UT 84116-3154
801-538-4700

USDA/APHIS Animal Damage Control
P.O. Box 26976
Salt Lake City UT 84126
(801-975-3315

Extension Wildlife Specialist
Department of Fisheries and Wildlife
Utah State University
Logan UT 84322-5210
435-797-3975

Utah Department of Agriculture
350 North Redwood Road
Salt Lake City UT 84116
801-538-4171

Neutroleum Alpha is available through:
Pocatello Supply Department
U.S. Fish and Wildlife Service
238 Dillon Street
Pocatello ID 83201
208-326-6920



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Wildlife Damage Management Series

Voles

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Department of Fisheries and Wildlife
Jack H. Berryman Institute
Utah State University, Logan, Utah

USU Extension in cooperation with:

CNR—Quinney Professorship for Wildlife Conflict Management
Jack H. Berryman Institute
Utah Division of Wildlife Resources
Utah Department of Agriculture and Food
USDA/APHIS Animal Damage Control

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Voles are rodents that belong to the genus *Microtus*, which translates to "small ear." This term appropriately describes vole's small, partially hidden ears. Voles are small (< 10 inches in total length) animals with stocky bodies, short legs and a short tail (Figure 1). Their underfur is dense and covered with thicker, longer guard hairs. Although many color variations may occur, voles typically are brown or gray.

Twenty-three vole species exist and occur throughout the United States. Of these 23 species, five occur within Utah; the prairie vole (*Microtus ochrogaster*), the meadow vole (*M. pennsylvanicus*), the long-tailed vole (*M. longicaudus*), the montane vole (*M. montanus*), and the water vole (*M. richardsonii*).

GENERAL BIOLOGY AND BEHAVIOR

Voles occupy a wide variety of habitats, depending on the species. Generally, voles prefer areas with heavy ground cover of grasses, grass-like plants, or litter. When two or more species inhabit an area, they generally occupy different habitats. Voles can be found in orchards and cultivated fields. They are active both day and night and throughout the year. Voles eat a variety of plants and animals. They frequently forage on grasses, forbs, roots, bark, snails, and insects. To find food, voles construct tunnels and surface runways with many burrow openings (Figure 2). Several adults and young can live in these runway systems. This intricate network of tunnels and

Figure 1. Montane vole, *Microtus montanus* (left), and Prairie vole, *M. ochrogaster* (right).

burrows provide voles with excellent shelter from the weather and protection from predators.

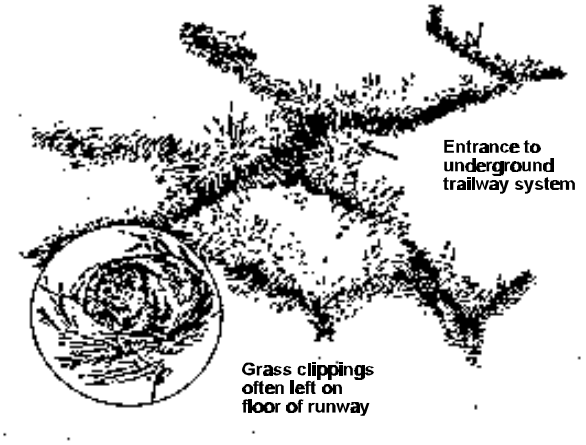

Figure 2. Surface runway system of the prairie vole.

Voles breed throughout the year, with peaks occurring during spring and summer. Voles can produce up to five litters per year ranging in size from 1 to 11 young. Although gestation periods vary slightly among species, 21 days is the average length of gestation for voles. Young are weaned by the time they are 21 days old, and females are sexually mature within 40 days.

All vole species are subject to large population fluctuations. Population levels generally peak every 2 to 5 years, but these cycles are not predictable. These populations shifts may result in densities ranging from a few to several hundred voles per acre. In rare cases, vole populations may become extremely dense. During the early 1900s, vole populations were estimated at 25,000 per acre in areas of Nevada. Factors which have been shown to influence population levels include dispersal rates, food quality, climate, predation, physiological stress, and genetics.

VOLE PROBLEMS

Voles can cause severe damage to orchards, ornamentals, and tree plantings by girdling seedlings and mature trees, especially when populations are high. Studies in New York have demonstrated that girdling by voles can reduce fruit yield in apple orchards by as much as 66%. Girdling of woody plants primarily occurs during fall and winter. Field crops, lawns, and golf courses also may be damaged by vole's extensive runway and tunnel systems.

Fortunately, voles pose no major public health problems because of infrequent contact with humans. However, they can harbor disease organisms, such as plague and tularemia. For this reason, voles should never be handled. If you have to handle a vole, or any other species of wildlife, you should wear the appropriate protective clothing (e.g., leather gloves).

LEGAL STATUS

Voles are classified as nongame mammals and are protected by Utah state law. However, controls can be implemented when voles are causing damage.

CONTROL

Identification of Damage

Girdling damage and gnaw marks caused by voles are similar to that of many other species of wildlife, particularly rabbits. This, coupled with vole's small size and inconspicuous nature, often leads individuals to believe vole damage is caused by other wildlife species. Vole girdling is characterized by non-uniform gnaw marks which occur at various angles and in irregular patches. In contrast, rabbits clip branches with neat, clean cuts. Additionally, gnaw marks left by voles characteristically are about 1/8 inch in width and 3/8 inch in length; gnaw marks caused by rabbits usually are larger than this. Careful examination of girdling damage may be needed to identify the animal that caused damage. However, perhaps the most prominent sign of vole damage is the presence of their extensive runway system. Runways are 1 to 2 inches in width and vegetation is often clipped close to the ground next to well-traveled routes (Figure 2).

Habitat Modification

The elimination of weeds, ground cover, and litter around lawns and ornamental plantings can reduce habitat suitability for voles and lead to a decreased likelihood of vole damage. For example, lawns should be mowed regularly and mulch should be cleared 3 feet or more from the base of trees. Additionally, soil cultivation destroys vole runway-systems and may kill voles outright. For these reasons, plots of annual plants often are less susceptible to vole damage than perennial plants.

Exclusion

Cylinders made of hardware cloth (available at most hardware stores) are often effective in excluding voles and protecting individual plants. The mesh size of the hardware cloth used to construct cylinders should be no larger than 1/4 inch in size. The cylinder should be buried at least 6 inches below the ground surface to ensure that voles will not burrow under the hardware cloth and gain access to the plant. Although this technique will protect individual plants, fencing typically is not effective in

protecting large areas (e.g., lawns) and probably is cost-prohibitive.

Repellents

The agency responsible for regulating chemicals used on wildlife, the Environmental Protection Agency (EPA), currently approves two chemicals for use in repelling voles. These two repellents may contain thiram (a fungicide) or capsaicin (chemical that makes peppers "hot") and act by altering the taste of plants and making them unpalatable to voles. Although these repellents may provide temporary protection for plants, their effectiveness usually is short-lived. Voles may become accustomed to such repellents and forage on plants even after treatment. For a more long-term prevention effort, other techniques should be considered.

Toxicants

The EPA also currently approves of two toxicants which may be used to lethally control vole populations. The toxicants are zinc phosphide and anticoagulants. Of these, zinc phosphide is more commonly used. Zinc phosphide (2%) is available in pelleted and grain bait formulations and typically is broadcast at rates of 6 to 10 pounds per acre. Additionally, zinc phosphide baits may be placed by hand in runways and burrow openings. Occasionally, it may be necessary to prebait (placement of nontreated bait prior to applying toxic baits) an area where voles hive become shy of toxic baits. Although zinc phosphide baits can be highly effective in reducing vole populations, you should be aware that this chemical is also toxic to ground-feeding birds, particularly waterfowl. Hand-placing baits in burrows and runways greatly reduces the risk of birds feeding on zinc phosphide baits. Zinc phosphide is also toxic to humans when ingested and may be absorbed through the skin. For these reasons, you should always wear gloves when handling zinc phosphide baits and dispose of the gloves in a safe manner. Additionally, zinc phosphide baits should be kept away from small children. Zinc phosphide is considered a restricted-use chemical. As such, to use zinc phosphide baits you must be a certified applicator. If you are interested in becoming a certified applicator, contact your local Utah State University county extension office.

Anticoagulant baits are also an effective means of reducing vole populations. Anticoagulants often are used to reduce rodent populations in general; approximately 95% of mouse and rat control is performed with anticoagulants. As with zinc phosphide baits, anticoagulants can be broadcast over an area or placed by hand in runways and burrows. Additionally, anticoagulant baits are often glued to the inside of a water repellent paper tube to make an effective, disposable bait container. Anticoagulants work much slower than zinc phosphide and death is delayed for several days following the ingestion of a lethal dose. This slow action offers an important safety advantage where pets or livestock frequent because it provides time to administer the antidote (Vitamin K_1) to an affected animal. Like zinc phosphide baits, anticoagulants can also be toxic to humans. Therefore, you should take precautions to prevent children from gaining access to anticoagulant baits.

For more information about these toxicants, their use, and how to obtain them, contact your local Utah State University extension office or any of the organizations listed at the end of this bulletin.

Other Methods

Frightening devices have been shown to be ineffective in reducing vole damage. Fumigants usually are not effective in controlling voles because the complexity and depth of vole runways and burrows allow the fumigant to escape before voles are exposed to it. Trapping may be effective in controlling very small vole populations, but, because of vole's high reproductive rate, the time and labor costs required to eliminate voles are probably prohibitive. In the event that voles invade your house (which is a rare event), individuals can be removed with snap traps or live traps as you would for house mice. Shooting generally is not regarded as a desirable method of vole population control.

ADDITIONAL SOURCES OF INFORMATION AND ASSISTANCE

For further information, contact:

Quinney Professor for Wildlife Conflict Management
Department of Fisheries and Wildlife
Utah State University, Logan, UT 84322-5210
Phone – (801) 797-3975 or 797-8847

Utah Division of Wildlife Resources
1596 West North Temple
Salt Lake City, UT 84116
Phone – (801) 538-4700

USDA/APHIS Wildlife Services
P.O. Box 26976
Salt Lake City, UT 84126
Phone – (801) 975-3307

Additional Reading:

Burt, W. H., and R. P. Grossenheider. 1976. A field guide to the mammals. 3rd edition. Houghton Mifflin Company, Boston, Massachusetts.

Hall, E. R. 1981. The mammals of North America. Volume 2, 2nd edition. John Wiley & Sons, New York.

Hygnstrom, S. E., R. M. Timm, and G. E. Larson, editors. 1994. Prevention and Control of Wildlife Damage. University of Nebraska Cooperative Extension, Lincoln, Nebraska, USA.

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