

DOMESTIC RATS AND MICE

Rodents expose humans to dangerous pathogens that have public health significance. Rodents can infect humans directly with diseases such as hantavirus, ratbite fever, lymphocytic choriomeningitis and leptospirosis. They may also serve as reservoirs for diseases transmitted by ectoparasites, such as plague, murine typhus and Lyme disease. This chapter deals primarily with domestic, or commensal, rats and mice. Domestic rats and mice are three members of the rodent family Muridae, the Old World rats and mice, which were introduced into North America in the 18th century. They are the Norway rat (*Rattus norvegicus*), the roof rat (*Rattus rattus*) and the house mouse (*Mus musculus*).

Norway rats occur sporadically in some of the larger cities in New Mexico, as well as some agricultural areas. Mountain ranges as well as sparsely populated semi-desert serve as barriers to continuous infestation. The roof rat is generally found only in the southern Rio Grande Valley, although one specimen was collected in Santa Fe. The house mouse is widespread in New Mexico, occurring in houses, barns and outbuildings in both urban and rural areas.

I. IMPORTANCE

Commensal rodents are hosts to a variety of pathogens that can infect humans, the most important of which is plague. Worldwide, most human plague cases result from bites of the rat flea, *Xenopsylla cheopis*, during epizootics among *Rattus* spp. In New Mexico, the commensal rodent species have never been found infected with plague; here, the disease is prevalent among wild rodents (especially ground squirrels) and their fleas.

Commensal rodents consume and contaminate foodstuffs and animal feed. In India, it has been reported that rats, mice and gerbils steal almost a quarter of all stored and standing grain. In fields, rodents can dig up and consume newly planted seeds. Because rodents tend to nibble on many foods, they destroy considerably more food than they consume. They also contaminate stored foods with their droppings and urine.

Rodents cause structural damage to buildings by their gnawing and nest building activities. They may chew up wiring and cause short circuits or even fires. Upholstery, insulation, and newspapers may be shredded for nesting material.

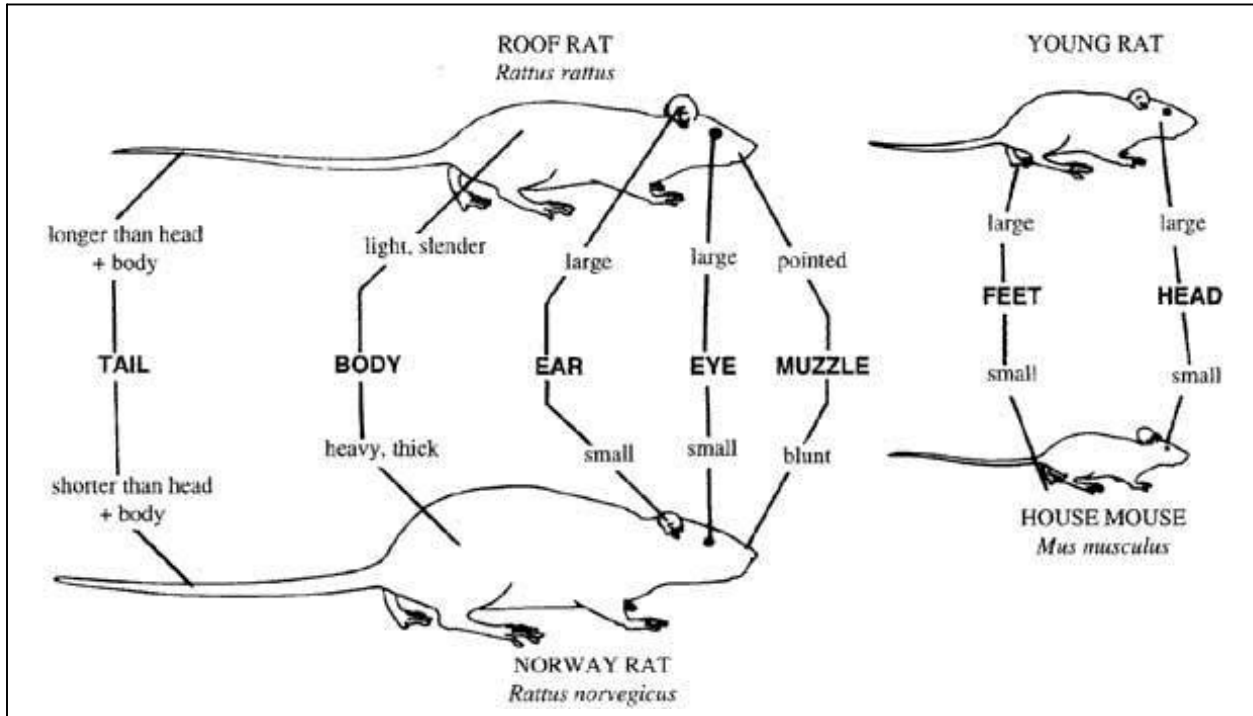
II. BIONOMICS

Rodents are characterized by having a single pair of incisor teeth on each jaw and by the absence of canine teeth. The domestic rodents can be distinguished from our native rodents by having a naked, scaly tail and white, buff or gray bellies. Native rats and mice, such as the woodrat (*Neotoma* spp.) or the deer mouse (*Peromyscus*) have well-haired, usually bi-colored tails, and white bellies and feet.

House mouse. The most common household rodent is the house mouse; they are considered among the most troublesome and economically important rodents in the U.S. Although house mice are commonly found living in man-made structures, they are also well adapted to living

outdoors, being common inhabitants of grassy fields and cultivated grain crops. These wild populations often move into buildings when weather becomes severe.

The house mouse is a small, slender, dusky-gray rodent with a slightly pointed nose; small, black, protruding eyes; and large, scantily haired ears. The adult mouse can be distinguished from a young roof rat because the head and feet of the mouse are distinctly smaller in proportion to its body size (see figure below). Adult house mice weigh $\frac{1}{2}$ to $\frac{3}{4}$ ounce and are $2\frac{1}{2}$ to $3\frac{1}{2}$ inches long in head-and-body length. The hairless tail is 3 to 4 inches long.



The house mouse is capable of exponential population growth. In a single year, a female can raise 5 to 10 litters, of 5 to 6 young each. Young are born 19 to 21 days after mating, and they reach reproductive maturity in 6 to 10 weeks. House mice generally live 9 to 12 months.

House mice have keen senses of taste, hearing, smell and touch. Although their ability to perceive objects is limited to 1 to 2 feet, they can see movement up to 45 feet. Mice are partially color blind as they are unable to see the color red. Mice use their sense of smell to locate food items and recognize other individual mice. House mice have acute hearing and readily respond to unusual noises as a means of detecting and escaping danger. However, they become accustomed to repetitive, ordinary noises, and, as a result, their activities may be more visible than those of rats. Mice maintain contact with walls using their whiskers and guard hairs to guide them during their nocturnal travels.



Mice are excellent climbers and can run up any rough vertical surface, balance along horizontal wire cables or ropes, and can jump vertically onto a flat surface 12 inches above the floor. Mice can squeeze through openings slightly larger than $\frac{1}{4}$ inch across. They typically gnaw $1\frac{1}{2}$ inch openings into cardboard and similar products. They will also gnaw electrical wiring, soap and other soft objects.

Mouse nests are made from finely shredded paper or other fibrous material and are found in sheltered locations such as walls, cabinets, upholstered furniture, or other convenient spaces. Urine and droppings mark the trail for others. They normally range 10 to 30 feet from the nest, but the distance traveled is resource dependent, and they may move vertically as well as horizontally.

House mice feed on a wide range of foods, although cereals seem preferred over other items. In particular, the germ of grains is favored by most mice. As supplemental diet items, mice often show preference for foods high in fat and protein, such as lard, butter, nuts, and dried meats. House mice are sporadic feeders, nibbling bits of food in various locations throughout their range. They require only $\frac{1}{10}$ ounce of food per day. Peak feeding periods are at dusk and around dawn but, because of their small size, mice must feed several times during a 24-hour period and thus are active day and night. They also cache food as supply permits. They can go long periods of time without free water, obtaining water from food. However it is not true to say they don't need water.

Rats. The two species of commensal rats are the Norway rat and the roof rat. The Norway rat (synonymous with brown, dump, barn, sewer, gray or wharf rat) is a burrowing rodent. Norway rats can be found in warehouses, farm buildings, houses, sewers, rubbish dumps, woodpiles and building foundations. The roof rat (black or ship rat) is somewhat smaller and is a more agile climber. Serious pest populations of roof rats are confined along the southern and western coastal areas of the country.

The **Norway rat** has a blunt muzzle, small eyes and short, close-set ears. Its fur is coarse and usually brownish- or reddish-gray, with whitish-gray hair on the belly. Its nearly naked, scaly tail is dark on the top and light on the underside and is shorter (6 to 9 inches) than the combined length of the head and body (7 to 12 inches). Adults weigh 12 to 18 ounces.

Norway rats are prolific breeders and mating occurs primarily in the spring and fall. Females give birth to 6 to 12 young just 21 to 23 days after mating and average 4 to 6 litters per year. Offspring become sexually mature in about 90 days. Individuals usually live 5 to 12 months.

The Norway rat eats about 10 percent of its body weight per day. Like the other commensal rodents, they are omnivorous, having become adapted to a wide variety of food including mixed garbage, meats, grain products, and eggs. They also require about 1 to 2 ounces of water each day and are usually found within a few yards of water sources such as leaking faucets, farm and ranch ponds, livestock water tanks, and sewers. When searching for food and water, Norway rats

usually travel an area of about 100 to 150 feet in diameter; seldom do they travel any further than 300 feet from their burrows or nests.

The **roof rat** has a slender body, prominent ears and large eyes. Roof rats have large, membranous ears and sharply pointed muzzles. The fur color ranges from light brown to black, with a gray to white belly. The unicolored, nearly hairless tail (7½ to 10 inches) is longer than the head and body combined (6½ to 8 inches). The adult weighs 8 to 12 ounces.

The roof rat is sexually mature at 3 to 5 months; females give birth to 5 to 8 young 22 days after mating. On average the female has 3 to 5 litters per year. Roof rats live about one year.

The roof rat requires about ½ to 1 ounce of food per day and up to 1 ounce of water. They will travel up to 300 feet for food.



Comparison of Norway rat (top left), roof rat (bottom left) and house mouse (right).

Both the Norway and roof rat have relatively poor vision but keen senses of smell, touch, taste and hearing. As with house mice, sensitive whiskers and guard hairs (longer hairs scattered through their fur that are more sensitive than the shorter hairs covering the body) help rats find their way in the dark. Rodents prefer to run along walls, between objects, and in well-defined runways where they keep their whiskers in contact with a vertical plane. They may gain entrance to structures by gnawing, climbing, jumping, or swimming through sewers and entering through the toilet or broken drains. While Norway rats are more powerful swimmers, roof rats are more agile and are better climbers. Rats of either species, especially young rats, can squeeze beneath a door with only a ½ inch gap.

Rats constantly explore and learn about their environment, memorizing the locations of pathways, obstacles, food and water, shelter, and other elements in their domain. They quickly detect and tend to avoid new objects placed into a familiar environment. Thus, objects such as traps and baits often are avoided for several days or more following their initial placement. While both species exhibit this “neophobic” behavior, it is more pronounced in roof rats than Norway rats.

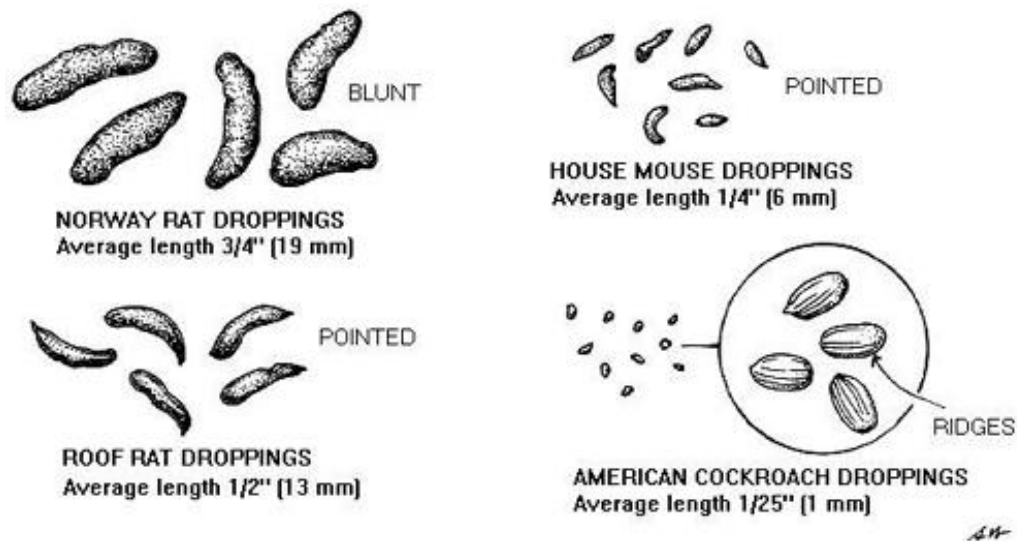
Norway rat burrows are found along building foundations, beneath rubbish or woodpiles, and in moist areas in and around gardens and fields. Nests may be lined with shredded paper, cloth, or other fibrous material. Roof rats prefer attics, trees and overgrown shrubbery or vines. Residential or industrial areas with mature landscaping provide good habitat, as does riparian vegetation of streams and ditches. Roof rats can often be seen at night running along overhead utility lines or fence tops. They have an excellent sense of balance and use their long tails for balance while traveling along overhead utility lines. When rats invade buildings, Norway rats usually remain in the basement or ground floor, while roof rats are most often found in enclosed or elevated spaces in attics, walls, false ceilings, and cabinets.

III. RECOGNIZING RODENT SIGN

Normally rats and mice are nocturnal, so recognition of various signs is necessary in determining population levels. Some of these signs are fecal droppings, runways, tracks, rub marks, burrows, gnawing activity, odor and sounds.

Droppings: Fresh droppings are moist, shiny, and dark; old ones are dry, dull, grayish, and crumble when pressed. The age of the droppings is important in determining whether an infestation is current. Droppings are most numerous along runways, near burrow entrances and at feeding sites. House mouse feces are $\frac{1}{8}$ inch to $\frac{1}{4}$ inch long, rod-shaped and tapered at one or both ends. Mice deposit approximately 50 to 75 pellets per day. Norway rat feces are capsule-shaped and about $\frac{3}{4}$ inch long. Roof rat feces differ from those of the Norway rat in that they are about $\frac{1}{2}$ inch long and spindle-shaped.

Urine stains fluoresce under ultraviolet ("black") light. Other items also fluoresce under black light, so this method must be supported by other evidence of rodent infestation.

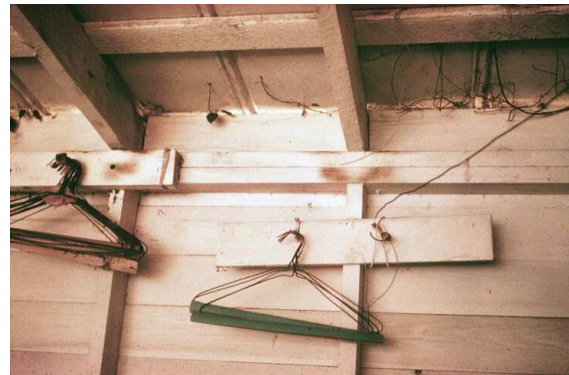


Runways: Rats and mice are creatures of habit and will travel the same pathways between their shelter, food and water sources. Outdoors these appear as packed earth paths; they are also

evident in dense vegetation. Indoors, runways are usually along walls, under boards, behind stored objects and similar places.

Tracks: Fresh tracks are distinct; old ones are faint. Tracks are more easily seen by side illumination from a flashlight than by direct light from above. Tail drags, as well as footprints, may show up. A smooth patch of flour or talc laid down in a runway may show current activity.

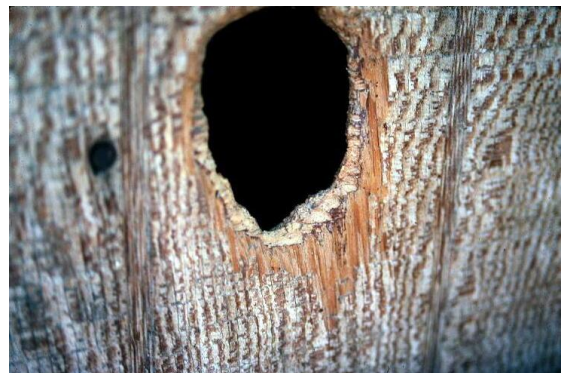
Rub marks: Dirt and oil from the rodents' fur leaves rub marks, usually along walls on well-traveled routes. Roof rat rub marks are seen overhead as swing marks beneath beams or rafters where they connect to the walls. Rub marks left by mice are less obvious.



Rub marks next to Norway rat burrow (left) and swing marks made by roof rats on rafters (right).

Burrows and Nests: Norway rats prefer to burrow in earth banks, under rubbish piles and concrete pads, along walls and in haystacks. Earth will be packed around active burrows; unused burrows may have cobwebs in the entrance. House mouse burrows are difficult to find, as they usually take advantage of other cover provided. Roof rats occasionally burrow, but usually make nests in trees or dense shrubbery, or in upper reaches of infested buildings. Norway rat and house mouse nests are well concealed and difficult to find.

Gnawing: Rodent incisors are continually growing (rat incisors grow 4 to 6 inches per year) so the rodents must gnaw on hard objects to wear down their teeth. To get to food, they gnaw any material with a gnawing edge that is softer than the enamel on their teeth. Fresh gnaw marks in wood are pale in color, with rough edges. Marks become dark and smooth over time when used by the rodents as an entrance. The size of the tooth marks left in the wood can help distinguish the presence of rats or mice.



Odor: House mouse infestations result in a strong, musky odor that is distinguishable from that of rats or native mice. The experienced rodent control specialist can learn to recognize the odor of house mice.

Sounds: Sounds of running, gnawing, scratching and squeaking may be heard in infested buildings, especially in double walls and false ceilings.

IV. PRINCIPLES OF RODENT CONTROL

Controlling rodent populations, not individual rodents, is the key to a successful rodent control program in any community. Populations are changed by changing the capacity of the environment to support rodents.

Reproduction, mortality and movement into and out of an area determine the potential size of rodent populations, whereas the physical environment (food, water, and shelter), predation, and competition are the limiting factors that control the actual population size.

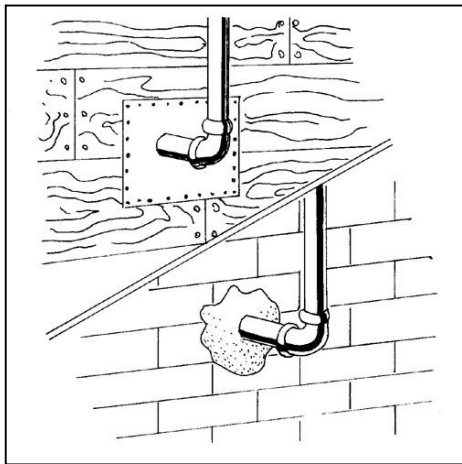
Effective rodent control involves three aspects:

1. **Rodent-proof construction**
2. **Sanitation**
3. **Population reduction through traps or poison**

The first two are preventive measures. When rodents are already established in an area, some form of population reduction is almost always necessary.

V. RODENT-PROOF CONSTRUCTION

Rodent control in structures is based on one simple rule: **rodents must be prevented from entering a building**. Excluding rodents by closing all possible holes through which they can enter a structure is always the most important measure against infestation. The paired front teeth (incisors) of rats and mice curve slightly inward, making it difficult for them to gnaw on flat, hard surfaces. When given a rough surface or an edge to bite, however, they can quickly gnaw into most materials.



Seal cracks and openings in building foundations, and any openings for water pipes, electric wires, sewer pipes, drain spouts, and vents. No hole larger than $\frac{1}{4}$ inch should be left unsealed to exclude both rats and mice. Use durable materials resistant to gnawing such as cement, concrete, galvanized sheet metal, lath screen, or hardware cloth (wire mesh). Make sure doors, windows, and screens fit tightly. Their edges can be covered with sheet metal if gnawing is a problem.

Steel wool is an effective and easy-to-use filler for small holes, but it rusts and cannot be used where moisture is present. Rodents often work their way between the steel wool and edges of the opening. “Stuff-It” is a compressible copper mesh that is reported by the manufacturer to be rodent-proof. However it is still best to seal openings filled with steel wool or

copper mesh with a high-quality caulking compound. Plastic sheeting, wood, rubber, vinyl, insulating foam and other less sturdy materials are likely to be gnawed away. See the National Park Service manual in the list of references for a more thorough discussion of rodent-proof materials and methods.

Because rats and mice are excellent climbers, openings above ground level must also be plugged. If roof rats are a problem, rodent proofing usually requires careful inspection of the roof line area to find all access points and ensure they are sealed.

Curtain walls are sunken L-shaped walls that prevent rats from burrowing under buildings. Foundations that extend to a depth of three feet below ground level and/or buildings with concrete slabs are more effective at excluding rodents; buildings that have these probably do not require curtain walls. The curtain wall should extend a minimum of two feet below ground level with a horizontal arm of at least 12 inches. Rats seeking entrance will burrow down to the horizontal arm but will not find their way around the edge.

Maintain a clean, 3-foot-wide, weed-free area around building foundations, concrete slabs, and footings to discourage rodents from burrowing. Maintain the buffer by mowing vegetation regularly or by applying 3 inches of 1½ inch crushed rock.

VI. SANITATION

Good sanitation removes water, food, and shelter resources required by rodents, and limits the number of animals that can live in an area. Good sanitation is very important for controlling rodent populations, but even the best of sanitation measures will not prevent infestations where exclusion is inadequate.

Inside (Food and Water): Reduce and eliminate all possible food and water available to rodents. Store all foodstuffs (e.g., dry pet food, grains, bread) in covered glass, metal, or durable plastic rodent-proof containers. Keep stove tops clean, and clean frequently around stoves and lower stove drawers. Clean frequently under bottom drawers in built-in kitchen cabinets. Continuously clean up all crumbs in the kitchen, and never leave leftover food or dirty dishes out. Promptly remove uneaten pet food. Promptly repair all water leaks.

Proper refuse handling: Keep all garbage cans tightly covered, remove garbage from buildings every night, and empty outdoor garbage containers at least twice a week.

Inside (Harborage): Mice and rats will nest in anything that doesn't move. Eliminate clutter such as stacks of paper, cardboard boxes or unused and broken equipment that rodents could use for shelter. Bulk foods in restaurant storage rooms should be on shelves at least 18 inches off the floor and 12 inches away from walls.

Outside premises: Remove debris and weeds that provide hiding places for rodents. Non-operative vehicles should be either fixed or removed to auto salvage yards, as rodents readily utilize these for safe shelter. Remove piles of tires or trash, unnecessary lumber or woodpiles, brush piles, and other large objects that attract rodents. Houses and outbuildings in dilapidated

condition should be torn down and the pieces salvaged. Avoid ornamental plantings next to buildings as this creates attractive shelter for rodents. Trim plants that touch or overhang buildings back 3 to 4 feet. Store firewood, lumber, equipment, and other usable materials on racks 18 inches off the ground to deny rodents shelter underneath. Store livestock feed in covered, rodent-proof containers.

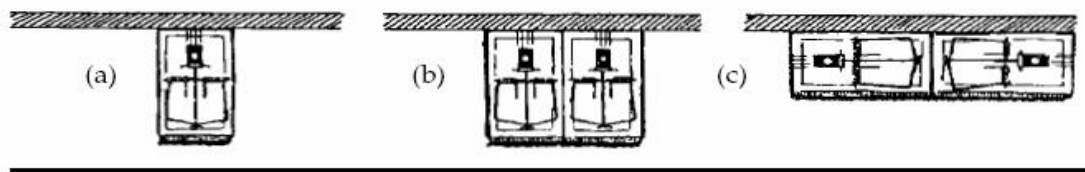
VII. POPULATION REDUCTION

TRAPPING AND GLUEBOARDS

Trapping is the safest and most effective method for controlling commensal rodents in and around homes, garages, and other structures. Because traps can be used over and over again, trapping is less costly than poison baits but more labor intensive.

The **snap trap** is one of the most effective devices for killing rats and mice, particularly mice. The simple wooden snap-trap is commonly used and is available in two sizes for mice and rats. Newer traps with large plastic treadles are especially effective. Snap trapping allows immediate disposal of the dead rodent, another advantage over rodenticides.

Peanut butter is very attractive bait to mice; nuts, dried fruit or bacon are excellent for rats. Solid baits should be tied securely to the trigger with light string or thread. Leaving traps baited but unset until the bait has been taken at least once improves trapping success by making the rodents more accustomed to the traps. Set the traps in rodent runways, such as along walls in quiet, dark locations. Place the trap perpendicular to the wall with the trigger against the wall. To prevent the rodent from avoiding the trap by jumping over it, two traps can be set together, either side by side, or both parallel to the wall with the triggers facing away from each other. Re-arrange objects in the runway to force rodents to jump onto the traps. Traps should be set out of reach of children, pets and non-target animals such as birds.



Placement of snap traps: (a) single trap with trigger next to wall; (b) the double set increases your success; (c) double set placed parallel to the wall with triggers to the outside.

For roof rats, the best places for traps are off the ground in locations where rats may be coming down from their nests to find food such as on ledges, shelves, branches, fences, pipes or overhead beams. The traps need to be secured to the ledge, etc. with screws or wire. Traps with an expanded treadle work best.

When determining how many traps to put out, consider the small home ranges for these animals. Space traps no more than 10 feet apart in areas where mice are active, and 10 to 20 feet apart for rat infestations.

Two other methods used for mouse control are **multiple-catch live traps** and **glue boards**. Multi-catch traps work on the principle that mice will readily enter small holes. These traps either have a spring-loaded mechanism that entraps mice in a holding compartment, or a one-way door that mice can enter but not exit. They can catch several mice at a time without being reset, so labor requirements are reduced. Glue boards catch and hold mice that are attempting to cross them, in much the same way flypaper catches flies. Place glue boards along walls where mice travel. Do not use glue boards where children, pets or wildlife can be caught on them. (Vegetable oil can be used as a solvent to loosen the glue in case a non-target animal is caught). Glue boards lose their effectiveness in dusty areas, and temperature extremes also adversely affect the tackiness of the glue.

The problem with both live traps and glue boards is that you need to humanely dispose (kill) the live mice. Mice captured live should not be released outside. For this reason glue boards and live traps are not a good alternative for many people.

Not all mouse infestations inside homes and buildings are due to house mice. The **deer mouse** (*Peromyscus maniculatus*) and related species are common in New Mexico and readily enter homes and outbuildings. The deer mouse is the reservoir for hantavirus, which is released through the animal's urine, droppings and saliva. Glue boards and multiple-catch traps that capture the mouse alive should **not** be used for *Peromyscus* infestations. The trapped animal will urinate and defecate inside the trap or on the glue board, releasing airborne virus and increasing the risk of human disease. *Peromyscus* caught in snap-traps should be sprayed thoroughly with a disinfectant and double-bagged for disposal (also see Hantavirus chapter).

Ectoparasite control must be considered in New Mexico where flea-borne plague is enzootic. Apply an insecticide (according to label directions) before setting the traps so that any fleas that may jump off the captured animal will be controlled.

Trap failures may be due to using too few traps or trapping stations; improperly placing traps; or failing to remove trapped rodents, which become food for surviving animals.

RODENTICIDES

Baits to control rodents are formulated with an attractant (generally food) and a rodenticide (toxin). The rodenticides in these baits are either anticoagulants that cause death by internal bleeding, or nonanticoagulants that act as a direct toxin.

Anticoagulants destroy the clotting ability of the rodent's blood, causing the animal to die from internal bleeding. The active ingredients are used at very low levels and the onset of symptoms is delayed, so the rodent does not avoid the bait because of its taste or the onset of illness. The first generation anticoagulants require multiple feedings over several days before a lethal amount is ingested; fresh bait must be made available continuously for at least two weeks or as long as

feeding occurs. While the newer, second generation anticoagulants may be capable of causing death after a single feeding, the rodents do not die until several days after feeding on the bait. Therefore the method of setting the bait out is essentially the same as for the older products.

Anticoagulants have the same effect on nearly all warm-blooded animals, but the sensitivity to these toxicants varies among species. If misused, anticoagulant rodenticides can be lethal to non-target animals such as dogs, pigs, and cats. Because the anticoagulants are cumulative and slow acting, dead rodents may contain several lethal doses of toxicant, and secondary poisoning of pets and wildlife is possible if several rodent carcasses are consumed over a few days. While this secondary poisoning is possible, it is not common. Most fatalities in pets involve dogs and are due to the animal consuming the bait directly (primary poisoning) or a combination of direct bait consumption and secondary poisoning. Use extra caution with the single-feeding anticoagulant baits; exposure to even a single dead rodent killed by these might be enough to cause poisoning in a pet.

The antidote for accidental poisoning with anticoagulant rodenticides is Vitamin K₁. In cases of severe poisoning, whole blood transfusion is also used. Some anticoagulant baits contain a bittering agent that rats and mice will eat, but non-target animals (including children) find distasteful.

Nonanticoagulant baits are usually lethal after one feeding if the rodent ingested an adequate amount of toxin. Bromethalin, cholecalciferol, and zinc phosphide are common active ingredients in this group of baits. With the first two ingredients, toxic symptoms do not appear until after a lethal dose has been consumed; death occurs two to four days later. Zinc phosphide causes death within several hours after a lethal dose is ingested. If the rodent consumes a sublethal dose of bait which makes it sick, it will avoid the bait. To prevent bait shyness with zinc phosphide, prebaiting with nontoxic but similar bait is recommended to increase bait acceptance. Zinc phosphide is not designed to be used on a long-term basis but only as an initial “clean-out” where high rodent populations are found.

The nonanticoagulant baits do not accumulate in the tissue of the rodent, so predators or scavengers such as dogs and cats are less likely to be adversely affected by eating poisoned carcasses. However, no antidotes are available for nonanticoagulant baits, and children and other animals can be poisoned by eating the bait so it must be stored and used carefully.

MODE OF ACTION	DOSE	ACTIVE INGREDIENT
Anticoagulant	Multiple-feeding	Chlorophacinone, diphacinone, warfarin
Anticoagulant	Single-feeding	Brodifacoum, bromadiolone, difethialone
Central nervous system disruption	Single or multiple feeding	Bromethalin
Hypercalcemia (leaches calcium into bloodstream)	Single or multiple feeding	Cholecalciferol, Vitamin D ₃
Heart paralysis	Single-feeding	Zinc phosphide

Bait formulations. Rodenticides are available in many different bait formulations and choosing the correct one can be difficult. The target species' preference and the environmental conditions need to be considered. Baits should be fresh and of high quality. Here are some types of formulations and their advantages or disadvantages:

1. **Wax (paraffin) blocks:** These are ideal for high moisture situations such as in sewers or outdoors where seed baits may spoil quickly. Some have holes drilled in them to make them easy to hang or string in place. Wax blocks are less acceptable to mice than seed or grain baits.
2. **Extruded baits:** Similar in appearance to wax blocks, these are cooked, stabilized products with less wax than the paraffin blocks, but are more moisture and weather resistant than seeds or pellets. Wax blocks and extruded baits feature multiple edges that rodents like to gnaw.
3. **Pelleted baits:** Highly weatherable and palatable. Mice often carry food to other locations (called "translocation") and the pellet formulation makes it easy for them to do that. This can result in the bait being moved to an area that may endanger non-target animals, or contaminate food.
4. **Seed baits:** Formulated especially for mice, as seeds are one of their preferred foods. Usually packaged in "place packs" which the mice can tear open. Place packs keep the bait fresh.
5. **Meal baits:** Made from several different food-grade seeds and grains, meal baits have high acceptance among rodents. They are not weather-resistant and are usually packaged in place packs. Since they cannot be translocated, they should be considered where there is a possibility rodents could transport bait to sensitive areas near food, children or pets.
6. **Tracking powders:** Anticoagulant, or sometimes zinc phosphide, in a powder form that is placed in rodent runways or wall voids. The rodent ingests the poison when it grooms itself. Tracking powders have a higher percentage of active ingredient than baits and must be used with caution and where the poison cannot be tracked onto food or other sensitive areas. Apply a paper-thin coating to lessen rodent avoidance.
7. **Water baits:** May be useful where food supplies cannot be limited, such as grain warehouses, and where water is scarce. Liquid baits mix with water and can be placed in fonts or similar containers in areas inaccessible to pets, children and non-target wildlife.

With all rodenticides, read all label directions on the bait and only place it in areas that are specified on the label. Put bait in locations out of the reach of children, pets, domestic animals, and non-target wildlife or in tamper-resistant bait stations. Remove and properly dispose of all uneaten bait at the end of a control program. In addition, it is wise to collect and properly dispose of any dead rodents found during the course of rodenticide application.

There are several advantages to using bait stations. They protect the bait from weather and provide a safeguard to people, pets and other animals. In addition, rodents prefer to feed in dark, confined spaces rather than out in the open. Bait stations should have two openings, 1 inch in diameter for mice and 2½ inches for rats. Bait stations should be large enough to accommodate several rodents at once. Bait stations can also be used to hold snap traps instead of bait.

Bait stations must be resistant to destruction by dogs and by children under 6 years of age and must be constructed in a manner that prevents a child from reaching into the bait compartments and obtaining bait. If bait can be shaken from stations when lifted or tipped, stations must be secured or otherwise immobilized. As you would with any poison, take care to ensure safety to children and pets by limiting their access to the bait.

Bait stations must be labeled with the following information: 1) name of the active ingredient; 2) EPA Registration number; 3) applicator's name and phone number; 4) phone number of the New Mexico Poison Control Center -- 1-800-222-1222. Clearly label all bait stations with appropriate warnings, and store unused bait in a locked cabinet or other areas inaccessible to children and domestic animals.

Reasons why rodenticide baiting may fail:

1. The time period that bait is exposed is too short;
2. Insufficient bait is made available, and there is insufficient replenishment of the bait;
3. Too few bait stations are used, and they are placed too far apart;
4. Other food sources are available, or more convenient;
5. The bait formulation chosen is poorly accepted -- choose a different formulation;
6. Bait is not fresh;
7. Control program does not include a large enough area, allowing rodents to migrate in from other areas;
8. Rodents are resistant to the rodenticide; choose a toxicant with a different active ingredient, or use traps.

REPELLENTS AND ELECTRONIC DEVICES

No repellents are known to be effective on rats or mice. Given their adaptability, it is unlikely that an effective repellent will be found. Rodents quickly become accustomed to regularly repeated sounds. Ultrasonic sounds, those above the range of human hearing, have very limited use because they are directional and do not penetrate behind objects. They also lose their intensity quickly with distance. Little evidence supports the use of electronic, sound, magnetic or vibration devices of any kind. For this reason these devices have not been registered by the New Mexico Department of Agriculture for sale or use in the state.

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