

## Controlling House Mice

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This publication discusses ways to recognize and control damage caused by house mice.

House mice (*Mus musculus*) are highly adapted to human environments and can thrive under a variety of conditions (Figure 1). They are found in and around homes, farms, and urban lots, as well as open



Figure 1. House mouse. Photo by Robert Timm.

fields and agricultural lands. House mice are uncommon in undisturbed areas away from farms or towns.

House mice are a significant pest in the United States and cause an estimated \$20 million in damage to stored feeds and structures in Nebraska every year. House mice consume and contaminate food meant for humans, livestock, and other animals. They also damage structures and property, and transmit diseases such as salmonellosis and swine dysentery. Mouse urine has been implicated as a trigger for asthma in some people.

### Recognizing Mouse Infestations



Figure 2. Mouse dropping. Photo by Stephen M. Vantassel.

Property owners typically become aware of mouse activity after discovering droppings. House mice deposit approximately 50 to 75 pellets per day as they explore their environment. Mouse droppings usually do not collect in piles. Droppings average 1/8- to 1/4-inch in length with one or both ends narrowing to a point (Figure 2).

The droppings usually are black in color, but will vary according to the mouse's diet.

Fresh gnaw marks, 1/32-inch wide, provide another clue that mice are present. Mice typically gnaw 1/2-inch diameter, clean-cut holes into cardboard and similar products. They also will gnaw electrical wiring, soap, and other items of comparable hardness.

Mouse nests, made from finely shredded paper or other fibrous material, are found in sheltered locations in proximity to heat sources (e.g., water heaters, ovens, refrigerators). Occasionally, scratching and squeaking sounds come from ceilings and walls, indicating the presence of mice. People frequently

are surprised to learn that house mice can be responsible for so much noise. A musky odor can occur in areas with long-term presence by house mice. Finally, mice may be seen during their nocturnal travels, or less frequently, during daylight hours.

### House Mouse Facts

House mice are small rodents with relatively large ears and small black eyes. They weigh about 1/2-1 ounce and usually are light gray in color. An adult is about 5 1/2- to 7 1/2-inches long, including the 3- to 4-inch tail.

Although house mice prefer cereal grains, they will eat almost anything. An adult consumes only 1/10-ounce of food per day by nibbling bits of food during its travels. Mice also cache food as supply permits. Mice maintain contact with walls with their whiskers and guard hairs to guide them during their nocturnal travels. Mice are capable of exponential population growth. In ideal conditions, a female can raise 5 to 10 litters of 5 to 6 young per litter each year. Young are born 18 to 21 days later and reach reproductive maturity in 6 to 10 weeks. The life span of a mouse typically is 9 to 12 months.

House mice have superb physical and sensory abilities. They are capable of climbing any rough vertical surface, balancing along horizontal wire cables or ropes, and jumping vertically onto a flat surface 10 inches above a floor or across a 3-foot gap, run 4 to 6 mph, and survive a 9-foot vertical drop. Mice can squeeze through openings slightly larger than 1/4-inch in diameter. Mice are near-sighted: They only focus on objects 1 to 2 feet away, but they see movement up to 45 feet. Mice have some color vision but are unable to distinguish the color red. Humans hear frequencies up to 20 kHz but mice can hear in the ultrasonic range up to 45 kHz. Their sense of smell is highly developed, allowing them to detect down to 250 parts per billion.

### House Mouse Control

Effective control involves sanitation, exclusion, and population reduction.

**Sanitation.** Proper sanitation involves reducing available shelter and food from the interior and exterior of buildings. House mice cannot maintain large populations when the availability of living space and food are restricted. Begin inspections in areas located within 50 feet of food that also provide warmth, shelter, and protection from predators. Appliances that run constantly, such as refrigerators, water heaters, and furnaces, are favorite den sites for mice. Mice inhabit piles of debris, infrequently moved inventory, stacked wood, insulation, and other inaccessible areas.

Reduce available shelter by removing debris and moving and neatly restacking old inventory and woodpiles. Whenever

possible, keep materials at least 8 inches off the ground and at least 1 foot away from vertical walls to reduce the attractiveness to mice and to allow for easier inspections for mouse activity.

Reduce the availability of food by removing or modifying bird feeders, securing food (including pet food) in tight-fitting bins, and cleaning up spills. Total elimination of mice through sanitation alone, however, is almost impossible, as mice can survive in small areas with limited amounts of food, shelter, and no water. On the other hand, any neglect of sanitation will cause even the most aggressive control efforts to fail, due to the rapid reproductive rate of house mice.

**Exclusion.** Mouse-proof construction is a key element in an effective mouse control program. Mice are attracted to buildings when they detect openings and escaping heat. Prevent mouse entry by eliminating all openings  $\frac{1}{4}$  inch or larger. Secure gaps less than  $\frac{1}{2}$  inch around pipes with sealant or mortar to stop airflow. For larger gaps, use copper woven-wire mesh or a new product that uses stainless steel fibers to fill the gap. These products do not rust and are flexible enough to be wedged into small cracks and crevices by a flat head screw driver. Complete the job with the appropriate type of sealant or mortar to prevent air movement. Larger openings can be secured with wood, aluminum flashing, concrete, or  $\frac{1}{4}$ -inch wire mesh. Doors, windows, and screens should fit tightly. Cover the edges of doors and windows with metal to prevent gnawing. Latex, plastic, rubber, boards less than  $\frac{1}{2}$ -inch thick, or other soft materials are unsuitable for plugging holes used by mice. Refer to NebGuides G1530, *Rodent-Proof Construction—Structural*, <http://www.ianrpubs.unl.edu/sendIt/g1530.pdf> and G2017, *Rodent-Proof Construction—Drains and Feeding Equipment*, <http://www.ianrpubs.unl.edu/sendIt/g2017.pdf> for more information.

**Population Reduction.** Mouse populations can be managed directly through the use of traps and toxicants.

**Traps.** Trapping is the preferred method for controlling house mice in homes, schools, hospitals, and other sensitive areas because: 1) it is pesticide free; 2) it permits users to view their success; 3) it is versatile, as traps can be placed in a variety of areas and sets; and 4) it allows for disposal of trapped mice, thereby eliminating the potential for odors from the mouse carcasses. To trap mice successfully you must identify where mice are living and use a sufficient number of traps. Mice actively explore their territory, leaving their nest up to 40 times per day, but seldom venture beyond 50 feet from their shelter and food supply. Place traps behind objects, in dark corners, and areas where droppings have been found. Concentrate traps in areas where mouse activity is evident. Space traps no more than about 10 feet apart in areas where mice are active. Although more expensive, clam-style traps are convenient and allow for easy one-hand setting and removal of trapped mice.



Figure 3. Expanded trigger (left) and regular trigger (right) for snap traps. Photo by Robert Timm.

Snap traps come in a variety of models and designs. All are effective in catching mice. Traps with expanded triggers, however, have a higher capture rate (Figure 3).

Set the triggers to a sensitive setting so that they will fire easily. Place them close to walls so mice will pass directly over the trigger (Figures

4 and 5).

Double setting (placing two traps close to each other) is recommended in situations with high mouse activity. Be sure that at least 1 inch separates traps placed in a double set. Traps



Figure 4. Properly set traps at a corner. Photo courtesy UNL.



Figure 5. Properly set traps along a wall. Photo by Stephen M. Vantassel.

or new traps to your trapping effort. Research has shown that female house mice avoid traps that have caught dominant males. It is not enough to catch mice; you must catch both genders to ensure effective control.

**Handling Misfires:** If baits disappear without the trap firing, then the culprit could be insects or mice. Reset traps with a light or “hair trigger” or move traps to a new location. Do not apply insecticide to traps or bait. Secure a cloth to the trigger and apply a food lure to the cloth-covered trigger. The cloth will absorb the bait, forcing mice to tug at the cloth and trigger the trap.

Multiple-capture traps for mice, such as the Victor Tin Cat® and the Ketch-All® (Figure 6), also are available in hardware and feed stores. They can catch several mice at a time without being reset, thereby reducing labor requirements. Some multicatch traps can be used in conjunction with glue boards to ease cleaning and removal of carcasses. Multiple-catch traps are useful, especially outdoors, to catch mice before they enter buildings.



Figure 6. Victor Tin Cat® and Ketch-All® multiple-catch mouse traps with a mouse snap trap in the middle for comparison.

Glue boards are an alternative to traps. These sticky boards catch and hold mice attempting to cross, in much the same way that flypaper catches flies. Place glue boards along walls where mice travel. Some glue boards are scented with artificial peanut butter oil, while others are unscented. Both are effective. Never place peanut butter or other greasy items directly on the glue, as the oil will dissolve the glue, rendering it ineffective. Instead, place the peanut butter inside a plastic soda bottle cap and set it in the middle of the glue board.

Sometimes mice learn to recognize the dangers of glue boards and attempt to jump over the board. In these situations, place an additional board next to the original one to increase the required jumping distance. Glue boards lose their effectiveness in dusty areas unless covered. Extreme temperature also may affect the tackiness of glue boards. Do not use them where children, livestock, pets, or desirable wildlife can contact them. If a child or nontarget animal gets caught, use vegetable oil to dissolve the glue.

Box traps (“live mouse traps”) for mice are not recommended as mice should not be relocated or translocated. House mice are a non-native and invasive species that should not be released alive in Nebraska. Additionally, translocation is very stressful to animals, which then must reorient themselves to a new

positioned in this way can be baited or not. If you decide to bait, use peanut butter (avoid if allergies are a concern), caramel, chocolate, a commercial non-allergenic mouse bait, whole canary grass (*Phalaris canariensis*) seed, or nesting material, such as cotton balls.

Mice are most active before dawn and after dusk, so check traps in the morning to maximize success. As a rough guide, two dozen properly-placed snap traps will be sufficient to control a new mouse infestation in a 1,500

ft<sup>2</sup> structure. In a continuous trapping program, add clean

or new traps to your trapping effort. Research has shown that female house mice avoid traps that have caught dominant males. It is not enough to catch mice; you must catch both genders to ensure effective control.

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**Table I. First-generation anticoagulant rodenticides (multifeed) available as General Use Pesticides to control house mice.\***

Common Name	Percent Active Ingredient	Brand Names
Chlorophacinone	0.005 0.2 (tracking powder requires CPA*)	JT Eaton™, Ortho®, RoZol®
Diphacinone	0.005 0.2 (tracking powder requires CPA*)	Blue Death®, D-Con®, Ditrac®, Harris, JT Eaton™, Kaput®, Opticare®, Ramik®, Tomcat®
Warfarin	0.025	Bar Bait®, Bonide, Kaput®, Rat Control

\*Due to the higher percentage of active ingredient and the challenges with application, a Certified Pesticide Applicator (CPA) license is required to purchase tracking powders.

**Table II. Second-generation anticoagulant rodenticides (single feed) that are Restricted Use Pesticides (RUP) and require a license to use.**

Common Name	Percent Active Ingredient	Brand Names
Brodifacoum	0.0025 (Formus brand only) to 0.005	d-Con®, Final®, Formus, Havoc®, Jaguar®, Ropax®, Talon®-G, WeatherBlok®
Bromadiolone	0.005	Boot Hill®, Brigand, Contrac®, Hawk, Maki®, Tomcat®
Difenacoum	0.005	Prescription Treatment® Brand Sorex™, Victor®
Difethialone	0.0025	d-Con®, Fast Draw®, FirstStrike®, Generation™, Hombre® Ortho®

area, obtain shelter, and locate food while avoiding predators.

**Rodenticides.** Rodenticides come in a variety of active ingredients and formulations.

**Anticoagulant rodenticide baits.** Anticoagulant rodenticides (Tables I and II) generally are considered much safer than non-anticoagulant rodenticides because of their lower toxicity and known antidote (Vitamin K<sub>1</sub>). Anticoagulants cause death by internal bleeding, which occurs as the blood loses the ability to clot and capillaries are damaged. The active ingredients are used at very low levels, so bait shyness does not occur when using properly formulated baits. First-generation anticoagulants require mice to feed for several days before a lethal dose is ingested. Therefore, fresh bait must be made available to house mice continuously for at least two weeks, or as long as feeding continues. In contrast, second-generation anticoagulants typically require mice to feed only once to receive a lethal dose. Mice that receive a lethal dose begin dying in five days, no matter which generation of rodenticide is used. The delay in the lethal effect is necessary to help prevent bait shyness. If mice became sick immediately after feeding on the bait, those that recovered may associate their illness with the bait and avoid it in the future.

The U.S. Environmental Protection Agency (EPA) changed the status of second-generation anticoagulants from General Use Pesticides (GUP; available without a Certified Pesticide Applicator (CPA) license) to Restricted Use Pesticides (RUP; available only to CPAs) in 2011, due to potential hazards to wild-life, livestock, pets, and people (<http://www.epa.gov/pesticides/reregistration/rodenticides/consumer-prod.html#changes>). Other changes to GUP rodenticides include:

- may be sold only in block or paste form and accompanied by an EPA-approved bait station,
- may not contain brodifacoum, bromadiolone, difethialone, or difenacoum (second-generation anticoagulants),
- may not be sold in amounts greater than 1 pound, and
- must be applied in bait stations within 100 feet of man-made structures.

**Nonanticoagulant rodenticide baits.** Nonanticoagulant rodenticides are more toxic than anticoagulant rodenticides (Table III) and provide quick knockdown of a mouse population. They may be preferred where mice are abundant or where it is

difficult to get mice to accept bait for several days in succession due to competing food items. No antidotes are available for nonanticoagulant baits. Therefore, nonanticoagulant toxicants should be used by pest management professionals or other persons familiar with their use.

**Table III. Nonanticoagulant rodenticides used for house mouse control that are Restricted Use Pesticides (RUP) and require a Certified Pesticide Applicator license to use.**

Common Name	Percent Active Ingredient	Brand Names
Bromethalin	0.01	Assault®, Clout All®, Cykill, Fastrac®, Gladiator™, Gunslinger®, Rampage®, Real-Kill®, Tomcat®, Top Gun™, Victor®
Cholecalciferol	0.075	Agrid®, Terad®
Zinc phosphide	2.0 10.0 (tracking powder)	Eraze®, Zinc phosphide, ZP®

A complete listing of all available rodenticides registered for the control of house mice can be found at <http://www.kellysolutions.com/ne/pesticideindex.htm>.

Bait acceptance can be increased by “prebaiting” with non-treated bait for several days before the rodenticide is offered. If acceptance of prebait is poor, do not apply toxic bait, but change bait material or its placement. “Bait shyness” can occur with some nonanticoagulant rodenticides such as zinc phosphide, so it is best to use them only once per year at any location.

Remove all uneaten bait at the end of a baiting program and dispose according to the label’s instructions. Never leave nonanticoagulant baits exposed to the elements for more than four days.

### Proper Use of Rodenticide Baits

GUP rodenticides must be contained inside the appropriate type of bait station. Enhance safety by purchasing toxicants mixed with Bitrex®, a bittering agent that makes the bait less palatable to nontarget animals. Choose stations in the tier (Table IV) needed to protect the bait from nontargets in your area. Bait stations provide mice a confined and dark space to ingest more toxicant. Bait stations should have at least two openings, about 1-inch in diameter, and should be large enough to accommodate several mice at one time. Place fresh anticoagulant bait in these stations to control invading mice before breeding populations become established. For more information, refer to NebGuide G1646, *Bait Stations for Controlling Rats and Mice*, <http://www.ianrpubs.unl.edu/sendIt/g1646.pdf>.

**Table IV. Rodenticide bait stations and levels of tamper- and weather-resistance.** <http://www.epa.gov/oppsrrd1/reregistration/rodenticides/consumer-prod.html>

Bait Station Capabilities	Tier 1	Tier 2	Tier 3	Tier 4
Resistant to Children	Yes	Yes	Yes	No
Resistant to Dogs	Yes	Yes	No	No
Resistant to Outdoor Weather	Yes	No	No	No
Resistant to Indoor Conditions	Yes	Yes	Yes	Yes

Proper placement of bait stations is essential for successful control. Place stations where mouse activity is evident or as close as possible to those locations (preferably within 10 feet). Establish bait stations in and around the perimeters of buildings where it is impossible to exclude rodents. For mice living in wall spaces, place stations where mice can exit the walls such as along pipes, above drop ceilings, and on foundation sill plates. Consider placing stations inside wall voids if other access points are not available.

Check bait stations every few days at the beginning of a control program to ensure an adequate supply of bait. Reduce the frequency of checking as bait supply suggests. Successful use of rodenticides, particularly anticoagulants, requires an adequate supply of bait.

Use of bait around food preparation areas is not advised and is illegal for service establishments. Avoid or minimize the use of toxicants to control house mice in schools, nursing homes, and other areas where the young, elderly, or people with medical issues reside.

Sometimes mice avoid or become resistant to a particular toxicant, especially if it has been used for several years. Usually this avoidance behavior is due to bait spoilage, poor placement, or excessive (nontoxic) food availability. Correct these issues to resolve the problem. If it does not, consider switching to bait with a different active ingredient (see *Tables I-III*) or one manufactured by a different company.

On rare occasions, GUP rodenticides cannot resolve a mouse problem. Pest management professionals have access to RUPs registered for controlling mice. To obtain your own Certified Pesticide Applicators license, contact the Pesticide Safety Education Program at <http://pested.unl.edu> or 800-627-7216.

**Fumigants.** Fumigants (toxic gases) suitable for the control of house mice can be applied only by a CPA and are permitted only in nonresidential settings, such as grain elevators and railcars. Aluminum phosphide is the most commonly used fumigant registered for house mice. Fumigation for insect control, with other products, often leads to the incidental death of house mice. Where practical, fumigation is a quick way to achieve 100 percent rodent control. Fumigation can be expensive, especially when a structure must be tarped completely to contain the fumigant. Caution: fumigants are highly toxic to humans and other animals, and involve numerous restrictions.

**Electronic devices.** Although easily frightened by strange or unfamiliar noises, mice quickly become accustomed to regularly repeated sounds. Ultrasonic sounds have very limited use in rodent control because they are directional and do not penetrate through objects. They also quickly lose their intensity with distance. Researchers have found little evidence of electronic, sound, magnetic, or vibrating devices driving established mice or rats from buildings or providing adequate control.

**Predators.** Although cats, dogs, owls, and other predators may kill mice, they rarely provide effective mouse control because house mice are secretive and often live in structures that are inaccessible to predators. Mice often live in very close association with dogs and cats as food, water, and shelter provided to pets also aids mice.

**Safety and other precautions.** Carefully follow all rodenticide label recommendations. All rodenticides present some degree of hazard to humans, livestock, pets, and other nontarget animals. Place rodenticide baits only where house mice can access them. Use prepared or ready-to-use baits to reduce the risks involved in handling concentrated toxicants. Store unused bait, concentrates, and fumigants in a locked cabinet out of the reach of children and animals.

**Cleanup.** Pick up all accessible dead mice after a trapping or poisoning program. The following information is for small cleanup areas such as in a closet. Additional protective measures should be taken in situations where fecal contamination is substantial, over a large area, or where deer mice and white-footed mice (*Peromyscus* spp. known carriers of Hantavirus) have been identified. For more information on rodent diseases, visit the Centers for Disease Control website, <http://www.cdc.gov>.

House mice are not known to be carriers of hantavirus. However, since few people will be able to identify the rodents in their home, we advise caution during all cleanup activities.



**Figure 7. Spraying mouse carcass with disinfectant. Photo by Stephen M. Vantassel.**



**Figure 8. Picking up mouse carcass with gloved hand inside plastic bag. Photo by Stephen M. Vantassel.**

Wear protective waterproof gloves (latex or vinyl), and spray the carcass and trap with household disinfectant (e.g., Lysol®) or a 10 percent solution of bleach and water (*Figures 7-8*). Spray until wet.

Turn a sealable plastic bag inside out, insert your hand, and grab and remove the mouse from the trap. Turn the bag right side out so that the mouse is inside the bag. Seal the bag. Wrap the bagged mouse in newspaper or place it in a box and dispose of it with other household wastes in an outdoor trash container. Spray the trap and area of the original set with disinfectant and let dry. Alternatively, discard the trap. Carefully remove gloves by turning them inside out and dispose of them with other household waste. Wash hands thoroughly. Be forewarned that some surface staining may occur with the use of disinfectants.

To remove rodent feces, wear gloves and spray the feces and area with disinfectant until wet. It is critical that the feces and surrounding dust do not become airborne. Do not use a household vacuum or broom to collect feces. Wet a towel, rag, or mop to wipe up fecal material. Dispose of feces and cleanup materials with other household wastes.

If you feel ill or develop a fever within five days of handling mice and their droppings, seek medical attention. Inform medical personnel of your activities.

It is important to know that predictions regarding where poisoned mice on your property will die are impossible. Ideas suggesting that poisoned mice go outside to seek water or roam to the middle of the room are little more than hopeful speculations. Whether dead mice will cause an odor depends on the number of mice killed, the location of their death, relative humidity and airflow, the size of the mice, and the sensitivity of the resident's nose.

For additional information, explore the Internet Center for Wildlife Damage Management (<http://icwdm.org>) and the book *Prevention and Control of Wildlife Damage* available on the ICWDM site or contact your local Extension office.

**This publication has been peer reviewed.**

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