
HOUSE MOUSE

Integrated Pest Management for Home Gardeners and Landscape Professionals

The house mouse, *Mus musculus*, is one of the most troublesome and costly rodents in the United States (Fig. 1). House mice thrive under a variety of conditions; they are found in and around homes and commercial structures as well as in open fields and on agricultural land. House mice consume and contaminate food meant for humans, pets, livestock, or other animals. In addition, they cause considerable damage to structures and property, and they can transmit pathogens that cause diseases such as salmonellosis, a form of food poisoning.

IDENTIFICATION

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

Droppings, fresh gnaw marks, and tracks indicate areas where mice are active. Mouse nests are made from finely shredded paper or other fibrous material, usually in sheltered locations. House mice have a characteristic musky odor that reveals their presence. Mice are active mostly at night, but they can be seen occasionally during daylight hours.

While the house mouse hasn't been found to be a carrier of hantavirus, the deer mouse, *Peromyscus maniculatus*, (Fig. 2), which sometimes invades cabins and outbuildings in California, harbors the Sin Nombre virus, which causes a rare but often fatal illness known as hantavirus pulmonary syndrome (HPS). The house mouse is distinguished from the deer mouse by its overall gray coat. The deer mouse has larger eyes and a white underside with a distinct line of demarcation between the dark coloration on top and the white underside. In addition, the tail on the house mouse has

almost no fur on it, whereas the tail of the deer mouse is moderately to well furred and is light underneath and dark on top. Before attempting to clean up premises where deer mice have been present, contact your county health department or the California Department of Public Health, or see the Centers for Disease Control and Prevention Web site (www.cdc.gov/rodents/) for information about how to prevent hantavirus exposure.

BIOLOGY

Native to Central Asia, the house mouse arrived in North America on ships with settlers from Europe and other points of origin. A very adaptable animal, the house mouse often lives in close association with humans, along with Norway rats (Fig. 3) and roof rats (Fig. 4); however, mice are more common and more difficult to control than rats. For more information about rats and rat management, see *Pest Notes: Rats* listed in References.

Although house mice usually prefer to eat cereal grains, they are nibblers and will sample many different foods. Mice have keen senses of taste, hearing, smell, and touch. They also are excellent climbers and can run up any rough vertical surface. They will run horizontally along wire cables or ropes and can jump up to 12 inches from the floor onto a flat surface. Mice can squeeze through openings slightly larger than 1/4 inch across. House mice frequently enter homes in autumn, when outdoor temperatures at night become colder.

In a single year, a female may have 5 to 10 litters of about 5 or 6 young. Young are born 19 to 21 days after conception, and they reach reproductive maturity in 6 to 10 weeks. The life span of a mouse is usually 9 to 12 months.



Figure 1. House mouse.



Figure 2. The deer mouse is sometimes found in homes and outbuildings and is a reservoir of the deadly Sin Nombre hantavirus.



Figure 3. Adult rats, such as this Norway rat and the roof rat below, are much larger than mice.



Figure 4. Roof rat.

PEST NOTES

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CONTROLLING HOUSE MICE

Because house mice are so small, they can gain entry into homes and other buildings much more easily than rats. As a result, house mouse infestations are probably 10 to 20 times more common than rat infestations. Effective control involves sanitation, exclusion, and population reduction. Sanitation and exclusion are preventive measures. When a mouse infestation already exists, some form of population reduction such as trapping or baiting is almost always necessary.

A key to successful long-term mouse control is limiting shelter and food sources wherever possible. Trapping works well, especially when a sufficient number of traps are placed in strategic locations. Trapping also can be used as a follow-up measure after a baiting program. When considering a baiting program, decide if the presence of dead mice will cause an odor or sanitation problem. If so, trapping may be the best approach. After removing mice, take steps to exclude them so that the problem doesn't recur.

Several types of rodenticides are available, which can be purchased as ready-to-use baits that typically are labeled for use against only house mice, Norway rats (*Rattus norvegicus*), and roof rats (*R. rattus*). Because all rodenticides are toxic to humans, pets, and wildlife, take special precautions to prevent access to baits by children and nontarget animals.

Sanitation

Because mice can survive in very small areas with limited amounts of food and shelter, controlling them can be very challenging, especially in and around older structures. Most buildings in which food is stored, handled, or used will support house mice if the mice aren't excluded, no matter how good the sanitation. While good sanitation seldom will completely control mice, poor sanitation is sure to attract them and will permit them to thrive in greater numbers. Pay particular attention to eliminating places where mice can find shelter. If they have few places to hide, rest, build nests, or rear their young, they can't survive in large numbers.

Exclusion

Exclusion is the most successful and permanent form of house mouse control. Build them out by eliminating all gaps and openings larger than 1/4 inch. Stainless steel scouring pads make a good temporary plug. Seal cracks in building foundations and around openings for water pipes, vents, and utility cables with metal or concrete. Doors, windows, and screens should fit tightly. It may be necessary to cover the edges of doors and windows with metal to prevent gnawing. Plastic screening, rubber, vinyl, insulating foam, wood, and other gnawable materials are unsuitable for plugging holes used by mice.

Traps

Trapping is an effective method for controlling small numbers of house mice. Although time consuming, it's the preferred method in homes,

garages, and other structures where only a few mice are present. Trapping has several advantages as it doesn't rely on potentially hazardous rodenticides, it permits the user to view his or her success, and it allows for disposing of trapped mice, thereby eliminating dead mouse odors that may result when poisoning is done within buildings.

Snap traps are effective and can be purchased in most hardware and grocery stores. The simple, wooden mouse-size snap trap is the least expensive option, but some people prefer the newer plastic, single-kill mouse traps because they are easier to set and clean. Snap traps with large plastic treadles are especially effective, but finding the best locations to set traps is often more important than what type of trap is used. Traps can be baited with a variety of foods; peanut butter is the most popular, because it is easy to use and very attractive to mice. Set the triggers lightly so the traps will spring easily.

Multiple-capture live traps for mice, such as the Victor Tin Cat and the Ketch-All, also are available from hardware stores and pest control suppliers. They can catch several mice at a time without being reset, reducing the labor involved. When using such traps, live mice need to be removed frequently and humanely euthanized.

Electrocution traps. Battery-operated traps that kill rats by electrocution (e.g., Rat Zapper and Victor) are considerably more expensive than other traps, but some homeowners, managers of commercial buildings, and pest control companies have found them to provide good house mouse control. As with snap

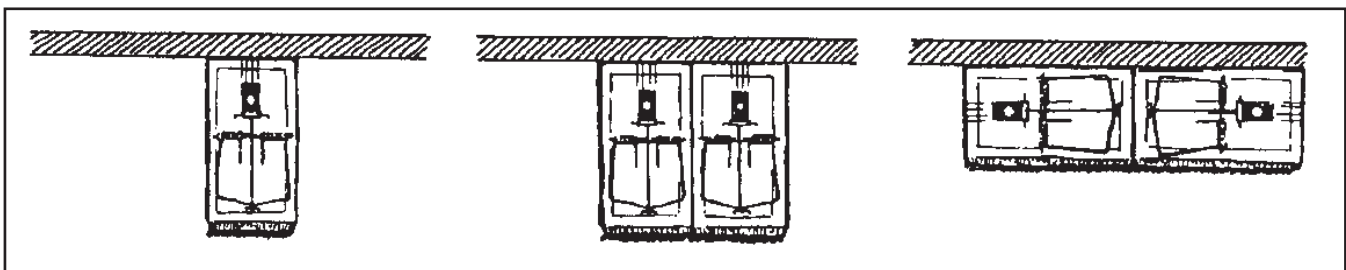


Figure 5. Placement of snap traps: (a) single trap with trigger next to wall; (b) double set, which increases your success; (c) double set placed parallel to the wall with triggers to the outside.

traps, for existing mouse populations it's important to use enough traps to achieve control in a timely manner. These traps need to be checked frequently, and dead mice should be removed for disposal.

Set traps behind objects, in dark corners, and in places where there is evidence of mouse activity. Place them close to walls so mice will pass directly over the trigger (Fig. 5). Traps can be set on ledges, on top of pallets of stored materials, or in any other locations where mice are active. Use enough traps to make the trapping period short and decisive. Mice seldom venture far from their shelter and food supply, so space traps no more than about 10 feet apart in areas where mice are active.

Glue Boards. An alternative to traps are glue boards, which catch and hold mice that are attempting to cross them in much the same way flypaper catches flies. They are available at many places where other rodent control products are sold.

A major drawback to glue boards and other live-catch traps is the trapped mouse might not die quickly, and you will need to kill it by delivering a sharp blow to the base of the skull using a sturdy rod or stick. Drowning isn't considered humane, although trap manufacturers sometimes suggest it. Releasing live-caught mice back to the outdoors frequently promotes increased mouse problems. Mice caught in glue traps can struggle for quite some time, and for this reason some people consider them to be less humane than kill traps.

If using glue boards, place them along walls where mice travel. Don't use them where children, pets, or desirable wildlife can contact them. Don't use glue boards to catch deer mice (*Peromyscus* species), as captured mice often urinate and defecate while stuck to the trap, thus increasing the risk of your exposure to hantavirus. Nontarget animals that become caught on the glue board can be removed in most cases by using vegetable oil as a solvent to loosen the glue. Glue boards lose their effectiveness in dusty areas unless covered. Extreme temperatures also may affect the tackiness of glue boards.

Table 1.

Anticoagulant Rodenticides for House Mouse Control Registered for Use in California.

First-generation anticoagulants	
Common name	Example products (trade names)*
chlorophacinone	J.T. Eaton AC, Rozol
diphacinone	Ramik, Sierra
warfarin	Kaput, Rodex
Second-generation anticoagulants	
Common name	Example products (trade names)*
brodifacoum	Final, Havoc, Jaguar, Talon
bromadiolone	BootHill, Confrac, Hawk, Maki
difenacoum	Di-Kill
difethialone	Generation, Hombre

*Always check the label for the active ingredient. The same or similar trade names may be used for products with different active ingredients.

Baits

Baits to control rodents are formulated with an attractant (generally food) and a rodenticide (toxin). Changes in rodenticide regulations went into effect in mid-2011 in an effort to prevent rodenticide hazards to wildlife and pets and reduce accidental exposure to children. These federal EPA restrictions now permit manufacturers to produce, for sale to the general public, only rat and mouse baits that are packaged in ready-to-use, disposable bait stations. Agricultural producers and professional pest control personnel are able to obtain more types of rodenticides in various formulations, some of which are restricted use pesticides.

Anticoagulant Rodenticides.

Anticoagulants are blood-thinning drugs that cause an animal's blood to lose the ability to clot, damaging capillaries and resulting in internal bleeding that is fatal. These active ingredients are used at very low levels and the onset of symptoms is delayed, so the rodent doesn't avoid the bait because of its taste or the onset of illness. When prepared with good-quality cereals and other ingredients, anticoagulant baits provide good to excellent house mouse control when baits are fresh and when placed in suitable locations so as to attract mice.

The various anticoagulant active ingredients currently registered for

use against house mice in California are listed in Table 1. Anticoagulants fall into two groups—the older “first-generation” compounds warfarin, chlorophacinone, and diphacinone, which require a rodent to consume multiple doses over a period of several days; and the newer “second-generation” compounds brodifacoum, bromadiolone, difenacoum, and difethialone, which can be fatal after a single feeding.

Since not all mice or rats will consume bait when it first becomes available, bait application directions typically recommend providing an uninterrupted supply of bait for at least 10 or 15 days or until evidence of rodent activity ceases. A rodent feeding on anticoagulant bait usually won't die until 2 to 6 days following ingestion of a lethal dose. This slow action is a safety advantage, allowing accidental poisoning to be treated before serious illness occurs; it also prevents mice from associating illness with a particular bait, thus preventing “bait shyness.”

This strategy of bait application, which is often needed for optimum rodent control, can result in a rodent ingesting an overdose of the second-generation anticoagulants, which are more effective in part because they persist longer in the rodent's body than do the first-generation anticoagulants. Thus, they also have the potential to be hazardous to predators and scavengers, which

may consume poisoned rodents. This secondary hazard from anticoagulants, as well as the primary hazard of nontarget animals directly ingesting rodent baits, is substantially reduced when baits are applied and used properly, according to label directions.

Because of the potentially greater hazard of second-generation anticoagulants to children, household pets, and nontarget wildlife, these active ingredients are no longer allowed to be manufactured for sale to the general public. Homeowners will be able to purchase only prepackaged, ready-to-use bait stations containing the first-generation anticoagulants (i.e., warfarin, chlorophacinone, or diphacinone) or the nonanticoagulants bromethalin or cholecalciferol. The second-generation anticoagulants (i.e., brodifacoum, bromadiolone, difenacoum, and difethialone) have never been approved for use in field situations or for use against ground squirrels, meadow mice (*Microtus*), pocket gophers, or any other rodents except house mice, Norway rats, and roof rats. Some of the second-generation rodenticides now labeled for use only by agricultural producers or professional pest control personnel may be restricted to applications in and around agricultural buildings.

Anticoagulants have the same effect on nearly all warm-blooded animals, but the sensitivity to these toxicants varies among species, and larger animals generally require a larger dose of toxicant than do smaller animals. Dogs are more susceptible to anticoagulant poisoning than are many other mammals, and small- to medium-sized dogs that seek out and consume rodents or rodent carcasses could be at greatest risk. Symptoms of anticoagulant poisoning in mammals include lethargy, loss of color in soft tissues such as the lips and gums, and bleeding from the mouth, nose, or intestinal tract. Vitamin K₁ is the antidote for anticoagulant rodenticides, although in cases of severe poisoning a whole blood transfusion is also used.

Table 2.

Other Rodenticides for House Mouse Control Registered for Use in California.

Common name	Example products (trade names)*
bromethalin	Assault, Gunslinger, Rampage
cholecalciferol	Agrid3, Quintox, Terad3
zinc phosphide	Eraze, Prozap, ZP

*Always check the label for the active ingredient. The same or similar trade names may be used for products with different active ingredients.

Other Rodenticides. Three other active ingredients are registered and used as rodenticides to control house mice and rats in California—bromethalin, cholecalciferol, and zinc phosphide (Table 2). Although not anticoagulants, application directions for bromethalin and cholecalciferol are somewhat similar to those for anticoagulant rodenticides. These two materials are formulated to serve as chronic rodenticides so that house mice will have the opportunity to feed on exposed baits one or more times over the period of one to several days. Bait acceptance is generally good when fresh, well-formulated products are used.

Zinc phosphide differs in that it is an acute toxicant that causes death of a house mouse within several hours after a lethal dose is ingested. Because zinc phosphide baits often require prebaiting (offering mice similar but nontoxic bait before applying the zinc phosphide bait) to get adequate acceptance, it's not commonly used against house mice and is infrequently available to consumers. An advantage of zinc phosphide bait is its ability to achieve a comparatively quick reduction of a mouse population; it's sometimes favored by pest control personnel and agricultural producers.

While risk of secondary poisoning to predators and scavengers is low because of the mode of action of these three rodenticides, primary hazard to nontarget animals (e.g., pets, domestic animals, and wildlife) that may consume rodent baits can occur when required precautions regarding bait placement aren't followed.

Bait Placement and Bait Stations. All rodenticide baits must be used

carefully according to the label directions, which have become more specific and more restrictive. Where it's impossible to exclude rodents from structures, mouse control can be accomplished by establishing permanent bait stations in buildings and around the perimeters of buildings. Place fresh bait in these stations to control invading mice before mouse populations become established. Check bait stations regularly and replace bait if it gets old or moldy, because mice won't eat stale bait.

Baits and bait stations containing bait now have more restrictive regulations regarding locations for use. Different designs of commercially manufactured bait stations may be required, depending on the particular situation and the bait formulation used. For example, some labels state tamper-resistant bait stations must be used if children, pets, nontarget mammals, or birds may access the bait. Some baits require that they be contained within bait stations for all outdoor, above-ground applications. Certain prepackaged bait stations intended for sale to homeowners can be used only inside structures and are prohibited for use in any area accessible to pets or for use outdoors. Other baits or bait stations may also be used around the periphery of structures or within 50 feet of a structure.

Because house mice seldom travel far from their shelter to find food, many product labels suggest making bait placements at 8- to 12-foot intervals. Place bait boxes next to walls, with the openings close to the wall, or in other places where mice are active. In all cases, the user must follow label directions.

Remove and properly dispose of all uneaten bait at the end of a control program. In addition, it's wise to collect and properly dispose of any dead rodents found during the course of a rodenticide application. You can pick them up using a sturdy plastic bag inverted on your hand, and either seal them in the bag for disposal with household garbage or bury them in a location where they won't be easily dug up by pets or scavengers.

Rodent Repeller Devices

Although mice are easily frightened by strange or unfamiliar noises, they quickly become accustomed to regularly repeated sounds. Ultrasonic sounds, those above the range of human hearing, have very limited use in rodent control, because they are directional and don't penetrate behind objects. They also lose their intensity quickly with distance. There is little evidence that sound, magnetic, or vibration devices of any kind will drive established mice or rats from buildings or provide adequate control. Despite their lack of effectiveness, many such devices continue to be sold through magazine advertisements and at some retail outlets.

Predators

Some dogs and cats will catch and kill mice and rats. There are few situations, however, in which they will sufficiently control rodent populations. Around most structures, mice can find many places to hide and rear their young out of the reach of such predators. Cats probably can't eliminate existing mouse populations, but in some situations they may be able to prevent reinfestation once mice have been controlled. In urban and suburban areas, it's common to find rodents living in close association with cats and dogs, relying on their food for nourishment. Mice frequently live beneath doghouses and soon learn they can feed on dog food when the dog is absent or asleep.

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To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

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WARNING ON THE USE OF CHEMICALS

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all chemicals in the original, labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

Pesticides applied in your home and landscape can move and contaminate creeks, rivers, and oceans. Confine chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits or vegetables ready to be picked.

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

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