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# HOUSE MOUSE

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## *Integrated Pest Management In and Around the Home*

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The house mouse (*Mus musculus*) is one of the most troublesome and economically important 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 agricultural lands. 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 ½ ounce and usually are light brownish to gray in color. 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 fine shredded paper or other fibrous material, usually in sheltered locations. House mice have a characteristic musky odor that identifies their presence. Mice are active mostly at night, but they can be seen occasionally during daylight hours.

While the house mouse has not been found to be a carrier of hantavirus, other mice have. Most notable are the deer mouse (Fig. 2) and the white-footed mouse, which sometimes invade cabins and outbuildings in California. The house mouse is distinguished from the deer mouse and the white-footed mouse by its overall gray-colored coat. The other two species have 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 tails of the deer mouse and the white-footed mouse are moderately to well furred and are light underneath and dark on top.

### 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 and roof rats; however, mice are more common and more difficult to control than rats.

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 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 ¼ inch across. House mice frequently find their way into homes in the fall of the year, 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 mating, and they reach reproductive maturity in 6 to 10 weeks. The life span of a mouse is probably 9 to 12 months.

### MANAGEMENT

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

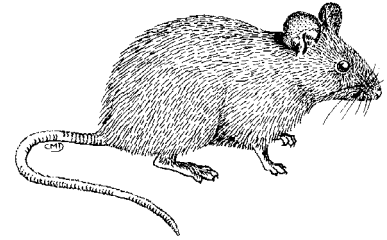


Figure 1. House mouse.

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 the limitation of shelter and of food sources wherever possible. Trapping works well when mice are not numerous, or it 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. Removal of mice should be followed by taking steps to exclude them so



Figure 2. Deer mouse.

that the problem does not recur.

Several types of rodenticides are used in baits. The anticoagulant rodenticides are most commonly available and can be used in and around buildings (Table 1). Because all rodenticides are toxic to humans, pets, and wildlife, take special precautions to prevent the poisoning of nontarget animals.

### **Sanitation**

Because mice can survive in very small areas with limited amounts of food and shelter, their control 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 are not excluded, no matter how good the sanitation. While good sanitation will seldom 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, or build nests and rear their young, they cannot 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 ¼ inch, through which mice will enter a structure. Steel wool makes 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 or 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 is the preferred method in homes, garages, and other structures where

only a few mice are present. Trapping has several advantages: (1) it does not rely on potentially hazardous rodenticides; (2) it permits the user to view his or her success; and (3) it allows for disposal of trapped mice, thereby eliminating dead mouse odors that may occur when poisoning is done within buildings.

Simple, inexpensive, wood-based snap traps are effective and can be purchased in most hardware and grocery stores. 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, so labor requirements are reduced.

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. 3). 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.

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. Place glue boards along walls where mice travel. Do not use them where children, pets, or desirable wildlife can contact them. 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.

One problem with live-catch traps and glue boards is that you need to dispose of the live mice. Cervical dislocation is an acceptable method of euthanasia. For mice caught on glue boards, this means taking a sturdy rod or stick and delivering a sharp blow to the base of the skull. Drowning is not considered humane, although it is sometimes suggested by trap manufacturers. Releasing live-caught mice back to the outdoors frequently promotes increased mouse problems.

### **Baits**

Baits to control rodents are formulated with an attractant (generally food) and a rodenticide (toxin). Most rodenticides used to control mice around the home are already mixed with an attractant in commercially ready-to-use baits. The rodenticides in these baits are either anticoagulants or other rodenticides such as single-dose toxicants and chronic rodenticides.

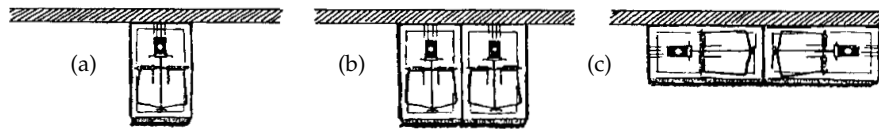
**Anticoagulant Rodenticides.** Anticoagulants cause death as a result of internal bleeding, which occurs as the animal's blood loses the ability to clot and capillaries are damaged. The active ingredients are used at very low levels and the onset of symptoms is delayed, so the rodent does not avoid the bait because of its taste or the onset of illness. When prepared with good-quality cereals and other bait ingredients, all anticoagulant baits provide good to excellent house mouse control if placed in suitable locations for the mice. The various anticoagulant active ingredients currently registered for use against house mice in California are listed in Table 1.

Because some anticoagulants require multiple feedings over several days before a lethal amount is ingested, fresh bait must be made available to mice continuously over a period of time. In practice, baits can be offered to mice for at least 2 weeks or as long as feeding occurs. While the newer anticoagulants (brodifacoum, bro-

madiolone, and difethialone) may be capable of causing death after a single feeding, the mice 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 anticoagulant products warfarin, diphacinone, and chlorophacinone.

Anticoagulants have the same effect on nearly all warm-blooded animals, but the sensitivity to these toxicants varies among species. If misused, anticoagulant poisoning can cause the death of pets, livestock, or desirable wildlife that may feed on the bait. Additionally, residues of anticoagulants that may be present in the bodies of dead or dying rodents can cause toxic effects to scavengers and predators. However, this "secondary hazard" from anticoagulants is relatively low when baits are used properly. 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. Because all rodenticides can be toxic to humans, particular care should be taken to keep rodent baits out of the reach of children. Vitamin K is the antidote for anticoagulant rodenticides, although in cases of severe poisoning, whole blood transfusion is also used.

All baits must be used according to the label directions. Use rat and mouse baits in a way that makes bait available solely to rats or mice. The newer anticoagulants (brodifacoum, bromadiolone, and difethialone) have never been approved for use in agricultural or 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. This is because these newer materials are more persistent in the body once ingested, and thus they may pose a greater hazard to nontarget wildlife, including predators and scavengers. Careful bait use will reduce the chance that rodenticide residues will occur in nontarget animals.



**Figure 3. 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.**

**Bait Selection and Placement.** Several formulations of anticoagulant baits are available. Grain baits or pelleted forms often are packaged in small plastic, cellophane, or paper packets or are sold in bulk. The "place packs" are designed to keep baits fresh and to make it easy to place baits into burrows, walls, or other locations. Mice will readily gnaw into place packs and feed on baits.

Anticoagulant baits formed into paraffin or wax blocks are useful in damp locations where loose grain baits spoil quickly. Unfortunately, mice may not accept these blocks as readily as they do other baits. Baits containing certain grass seeds are often particularly well accepted by mice, even in the presence of other competing food items.

Proper placement of baits is important for house mouse control. Place baits no more than 10 feet apart in areas where mouse activity is evident. If mice are living in wall spaces, place baits inside the walls.

**Other Rodenticides.** In addition to the anticoagulant baits, there are currently three other rodenticides available in California for use against the house mouse (Table 2). Although not anticoagulants, bromethalin and cholecalciferol are used in a manner somewhat similar to the anticoagulant products. 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.

The third material, zinc phosphide,

differs from bromethalin and cholecalciferol in that it is an acute toxicant that causes death of the mouse within several hours after a lethal dose is ingested. When using zinc phosphide baits, prebaiting (offering mice similar but nontoxic bait before applying the zinc phosphide bait) is recommended in order to increase bait acceptance. If acceptance of prebait is poor, do not apply toxic bait, but change the bait material or its placement. Zinc phosphide bait is not designed to be left available to mice for more than a few days, as continuous exposure is likely to result in the mice learning to avoid the bait, a behavior known as "bait shyness." The advantage of using zinc phosphide bait is its ability to achieve a comparatively quick reduction of a mouse population. Because bait shyness can occur with zinc phosphide baits, these products should not be used more frequently than once or twice per year at any given location.

When using any rodenticide, carefully follow label instructions and understand all precautions. Never place baits where children or nontarget animals can access them. 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. You can pick them up, using a sturdy plastic bag inverted on your hand, and seal them in the bag for disposal with household garbage, or bury them in a location where they will not be easily dug up by pets or scavengers.

**Bait Stations.** Bait stations are very useful when applying the chronic and single-dose toxicant rodenticide baits. They protect rodenticides from

**Table 1. Anticoagulant Rodenticides for House Mouse Control Registered for Use in California 2006.**

Common name (example trade names)	Chemical name
brodifacoum (d-CON, <sup>1</sup> Havoc, Jaguar)	3-{3-[4'-bromo(1,1'-biphenyl)-4-yl]-1,2,3,4-tetrahydro-1-naphthalenyl}-4-hydroxy-2H-1-benzopyran-2-one
bromadiolone (Boot Hill, Hawk)	3-{3-[4'-bromo(1,1'-biphenyl)-4-yl]-3-hydroxy-1-phenylpropyl}-4-hydroxy-2H-1-benzopyran-2-one
chlorophacinone (J.T. Eaton AC Formula 90)	2-[(p-chlorophenyl)phenylacetyl]-1,3-indandione
difethialone (d-CON, <sup>1</sup> Hombre)	3-(3-(4'-bromo(1,1'-biphenyl)-4-yl)-1,2,3,4-tetrahydro-1-naphthylenyl)-4-hydroxy-2H-1-benzothiopyran-2-one
diphacinone (Ramik)	2-diphenylacetyl-1,3-indandione
warfarin (d-CON, <sup>1</sup> Kaput Rat & Mouse Bait)	3-( $\alpha$ -acetylbenzyl)-4-hydroxycoumarin

<sup>1</sup> Always check the label for active ingredients (a.i.). The same or similar trade names may be used for products with different a.i.

**Table 2. Other Rodenticides for House Mouse Control Registered for Use in California 2006.**

Common name (example trade names)	Chemical
bromethalin (Assault, Rampage <sup>1</sup> )	N-methyl-2,4-dinitro-N-(2,4,6-tribromophenyl)-6-trifluoromethyl) benzenamine
cholecalciferol (Quintox <sup>2</sup> )	9,10-Seocholesta-5,7,10(19)-trein-3-betaol
zinc phosphide (Eraze Rodent Pellets, Prozap Zinc Phosphide Rodent Pellets)	zinc phosphide

<sup>1</sup> Always check the label for active ingredients (a.i.). The same or similar trade names may be used for products with different a.i.

<sup>2</sup> Not available to homeowners.

weather and provide a safeguard to people, pets, and other animals. 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 bait boxes next to walls (with the openings close to the wall) or in other places where mice are active. It is best to place bait stations between the source of shelter and the food supplies that the mice are using. Clearly label all bait boxes "Caution—Mouse Bait" as a safety precaution. Some rodenticide labels or situations may require use of approved tamper-resistant bait stations. If so, be sure to secure these stations to buildings by nailing or gluing

them to walls or floors in a way that will not permit a person or animal to knock them over or shake the bait out.

Where it is impossible to exclude rodents from structures, establish permanent bait stations in 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 and moldy, because mice will not eat moldy bait.

#### ***Electronic 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 do not penetrate behind objects. They also lose their intensity quickly with distance. There is little evidence that electronic, 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 cannot 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 is not uncommon to find rodents living in close association with cats and dogs, relying on cat and dog 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.

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 nor pour pesticides down 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 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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