DEER MOUSE

Integrated Pest Management for Home Gardeners and Landscape Professionals

The deer mouse, *Peromyscus maniculatus*, often referred to as a white-footed mouse, is the most abundant and widely distributed mammal in North America. A member of a large group of species and subspecies of the genus *Peromyscus*, deer mice are very proficient jumpers and runners that received their name due to their agility.

Deer mice are a particular concern because they spread hantavirus, which can be deadly to people. Because deer mice prefer forests, grasslands, and agricultural crops, they aren't normally found within urban and residential areas unless fields, forests, or other suitable habitats surround those areas.

IDENTIFICATION

There are seven species of mice belonging to the genus *Peromyscus* in California. The deer mouse (Figure 1) is the most widespread and common of these species. The other species are the brush mouse (*P. boylii*), the California mouse (*P. californicus*), the canyon mouse (*P. crinitus*), the cactus mouse (*P. eremicus*), the northern Baja deer mouse (*P. fraterculus*), and the pinyon mouse (*P. truei*).

These species are difficult to distinguish from one another, as almost all of them have characteristic white undersides, legs, and feet and dark to light brown backs. Their tail is bicolored, with white on the bottom and the darker color on top. Although white-footed mice typically exhibit larger eyes, ears, and overall body size, their bicolored tail is the easiest feature to use to distinguish them from house mice, *Mus musculus*; house mice also have almost furless tails and an overall gray-brown coat (Figure 2).

BIOLOGY AND BEHAVIOR

The deer mouse is found in all types of habitats throughout California including forests, grasslands, scrublands, and agricultural lands. Other species of *Peromyscus* are more restricted and are found in chaparral, pinyon-juniper, rocky canyons, and other similar environments.

Deer mice are nocturnal and spend the day in refuges or nests. Nests consist of stems, twigs, leaves, and roots of grasses and other fibrous materials and may be lined with fur, feathers, or shredded cloth. Nest sites include tree hollows, stumps, and roots as well as the underside of rocks and logs. Deer mice also nest above ground and have been known to utilize abandoned squirrel and bird nests or nest inside buildings. Deer mice don't hibernate, but they may become dormant (torpid) when the weather is especially severe. They nest in family groups throughout the winter.

Deer mice are predominantly granivorous, feeding on a range of seeds. However, they will also consume fruits, invertebrates, fungi, and to a lesser extent green vegetation. Deer mice are often known to cache their food and store some of their food near their nests, especially in autumn when foods such as tree seeds and nuts are most plentiful.

Deer mice don't usually breed during winter. However, the chronology and duration of breeding varies within and between populations. In the presence of abundant food supplies, reproduction can be prolonged and mice can breed over winter. In warm regions, reproduction may occur year-round.

Litter size is typically between three and six young. Female deer mice can be reproductively active as early as six weeks of age. In the wild, deer mice rarely survive for more than two years.

Figure 1. Adult deer mouse. Note the large ears and eyes and the white underside of the body and tail—all distinguishing characteristics between the deer mouse and house mouse.

Figure 2. House mice are frequently found in residential households. They lack a white underside and have a relatively hairless tail.

DAMAGE

Because of their small size, deer mice can gain entry into many buildings and often enter vacated homes, cabins, and other structures where they build nests and store food. However, deer mice aren't common in urban and residential areas unless large or numerous parks and/or fields are nearby. Deer mice damage upholstered furniture, mattresses, clothing, paper, or other materials they find suitable for constructing their nests. Nests, droppings, and other signs left by deer mice are similar to those of house mice. However, deer mice have a much

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greater tendency to cache food supplies such as acorns, seeds, or nuts than do house mice. This may help in the identification of the species of mouse responsible for the observed damage.

Deer mice are also a pest in some forested and agricultural lands. Seed predation by deer mice and other rodents has contributed to slow regeneration or complete reestablishment failure in coniferous forests, especially during the initial stages of regeneration. It is believed that deer mice are the most important predator of seeds in parts of the United States, particularly in Douglas-fir stands, where the deer mouse destroys more Douglas-fir seed than any other mammal or bird. Douglas-fir and other commercial coniferous species are often hand planted despite the added cost, as reforestation by direct seeding of clear-cut areas is particularly prone to predation by deer mice and other seed-eating rodents.

Deer mice are known to feed on seeds in row crops, dig up planted melon seeds, and eat alfalfa seed. High populations of deer mice also cause damage to almonds (Figure 3), avocados, citrus, pomegranates, and sugar beets.

Hantavirus and Precautions

Hantaviruses are a group of viruses that rodents in the family Muridae carry. Deer mice are the principal reservoir of one of these viruses called *Sin Nombre* virus, which causes Hantavirus Pulmonary Syndrome (HPS) in people. Although human cases of this virus are rare, HPS can be a severe respiratory disease in humans with fatality rates of about 36%. Deer mice shed the virus in their saliva, urine, and droppings. A person may be exposed to hantavirus by breathing contaminated dust after disturbing or cleaning rodent droppings or nests or by living or working in rodent-infested settings. There is no evidence that North American hantaviruses spread from one person to another.

The most effective way to avoid contracting hantavirus from deer mice is to keep them out of houses, cabins, and dwellings by rodent proofing and excluding them from these structures by sealing all small gaps and cracks. Once deer mice infest a dwelling, it is critical to avoid working and sleeping in these areas until the infestation has been controlled and the area has been made safe for humans.

Before occupying an infested house, cabin, or associated outbuilding, open the doors and windows to air out the room for at least 30 minutes. Where possible, use an electric fan on windowsills and in door entrances to assist in the process. Be sure to vacate the building during the ventilation process to prevent inhaling aerosolized particles. Wearing a commercially available cloth or paper breathing mask offers some protection and is better than no protection at all. However, only an approved respirator equipped with high-efficiency particulate air (HEPA) filters offers total respiratory protection against airborne viruses.

It is important to wear nonfabric gloves (e.g., rubber, latex, vinyl, or nitrile) when cleaning deer mouse-infested buildings. Because humans can contract the virus by inhaling aerosolized deer mouse urine and feces, never stir up dust by vacuuming or sweeping or through any other activity.

It is important to properly disinfect the potentially contaminated areas. Thoroughly wet contaminated areas, including trapped deer mice, droppings, and nests, with an appropriate disinfectant solution such as Lysol or a 10% hypochlorite (bleach) solution. To make this bleach solution, mix 1 1/2 cups of household bleach in 1 gallon of water (or one part bleach to nine parts water). Note that a bleach solution may damage rugs and fabrics and irritate skin. Wear nonfabric gloves whenever touching or cleaning contaminated surfaces or when handling mouse nests, dead mice, or mouse traps.

Once everything has soaked for 10 minutes, remove all nest material, mice, and/or droppings with a damp towel and then mop or sponge the area with the disinfectant solution. Upholstered furniture and carpets can be shampooed and steam cleaned. If you wish to reuse the gloves used while cleaning contaminated areas, you must properly disinfect them before removal. After removing the gloves, it is important to thoroughly wash hands with soap and water or use a waterless alcohol-based hand sanitizer when soap is unavailable and hands aren't visibly soiled.

Figure 3. A deer mouse has chewed open this almond and removed its nut meat.

For more up-to-date information on rodent cleanup, visit the Centers for Disease Control and Prevention Web site at http://www.cdc.gov/rodents/cleaning/index.html.

MANAGEMENT

The California Fish and Game Code classifies deer mice as nongame mammals. Nongame mammals found injuring or threatening crops or other property may be controlled at any time in any legal manner by the owner or tenant of the premises.

Effective management involves integrating several methods. Measures such as exclusion and sanitation or habitat modification can be applied to prevent infestations. When a mouse infestation already exists, population reduction by trapping and/or applying toxic bait is almost always necessary. Once a deer mouse population has been effectively controlled, it is important to monitor for signs of a reinfestation. Be aware of any signs of new activity. Signs of house mice activity look similar to those of deer mice; however, a telltale musky odor is typical of house mouse infestations.

Exclusion

Excluding deer mice from houses, dwellings, and other buildings by using rodent-proof construction is the most effective and permanent method to ensure the absence of deer mice and other rodent infestations in structures. Openings larger than 1/4 inch should be sealed, as mice will gnaw to enlarge these openings to gain entry. Steel wool makes a good temporary plug. Plastic screening, rubber, vinyl, insulating foam, wood, and other gnawable materials are unsuitable for plugging holes mice use.

Seal cracks in building foundations and around openings for water pipes, vents, and utility cables with metal or concrete. Doors and door screens, pet doors, windows, ventilation screens, and entrances to garages, attics, crawl spaces, and basements should fit tightly. It may be necessary to cover the edges of doors and windows with metal to prevent gnawing. If doors, windows, vents, and screens are damaged beyond repair, replace them immediately. Fit chimneys with a spark arrester to help prevent entry. Self-closing flaps on external clothes dryer vents can prevent rodent entry. However, use caution when screening dryer vents, as a buildup of dryer lint can cause fires. Remember to keep side doors to the garage closed, especially at night when deer mice and other rodents are most active.

Habitat Modification

Simple habitat modification can make gardens and yards less hospitable for deer mice. Clearing overgrown shrubs, hedges, and weeds can dramatically reduce cover and potential refuges for deer mice. Wood and brush piles, along with fallen trees, should be kept away from homes and other buildings, as these are prime nesting areas that could harbor deer mice that may enter homes and other buildings. While habitat modification can reduce numbers of deer mice in an area, it won't completely eliminate them, as a deer mouse's home range is 1/3 acre to 4 or more acres.

Frightening Devices and Repellents

Commercially sold ultrasonic devices and other frightening devices aren't effective at repelling deer mice. Chemical repellents, also commercially available for outdoor use, aren't sufficiently effective to justify their expense.

Trapping and Glue Boards

Snap traps and electrocution traps can be used to remove deer mice that are found in or around buildings. Peanut butter or peanut butter mixed with cereal or rolled oats is usually an effective attractant. A dozen or more traps may be needed to effectively control a large population in a timely manner. It is important to keep some traps set after the initial control period to prevent reinvasion or resurgence of the deer mouse population.

Trap placement is important. To maximize capture success, space traps no more than about 10 feet apart in areas where there is evidence of activity. Mice tend to run along walls, so if traps are placed at the juncture of a wall and the floor with the trigger pointed toward the wall, then the mouse will run directly across the trigger and very likely be caught.

When trapping, take precautions to prevent possible exposure to hantavirus. Wear rubber, latex, vinyl, or nitrile gloves when removing traps, resetting used and older traps, and disposing of dead mice. Thoroughly wet contaminated areas including trapped deer mice, droppings, and nests with an appropriate disinfectant solution; see Hantavirus and Precautions above. While deer mice can be captured in several commercially available multiple-catch mouse traps, use of these traps isn't recommended because of the greater potential for exposure to hantavirus. Live-capture traps quickly become contaminated with mouse feces and urine, and they also present the added problem of needing to humanely euthanize the trapped mice.

Glue boards are sold commercially for controlling mice and rat populations. Mice that become stuck on glue boards often urinate and defecate as they struggle to free themselves from the glue. When deer mice are captured in this way, the potential for contacting hantavirus is greatly increased. Therefore, avoid glue boards for controlling deer mice.

Biological Control

Deer mice and other members of the genus *Peromyscus* are popular prey for many reptiles, birds, and predatory mammals. Collectively, snakes, owls, weasels, skunks, badgers, foxes, coyotes, and bobcats can consume large numbers of deer mice. However, such natural predation isn't generally enough to control deer mouse populations to a low enough level to prevent damage or risk of exposure to hantavirus.

Dogs and cats can catch and kill deer mice. However, it is unlikely they will effectively control deer mouse populations, and other control methods will be required. Cats may be able to control the reinfestation of deer mice once populations have been reduced or eliminated. However, in urban settings mice often live in close association with cats and dogs. Dog houses, sheds, and other shelter available within residential areas also provide refuge for some rodents, and food left out for pets as well as spillage from bird feeders often encourage rodent infestations.

Toxicants (Rodenticides)

Often, when a deer mouse population has become quite high, toxic bait (rodenticides) can serve as a valuable component of an IPM program for controlling these populations. Rodenticides can be divided into three different groups, according to the active ingredient:

- First-generation anticoagulants: warfarin, chlorophacinone, and diphacinone (only the second two are registered for use against deer mice);
- Second-generation anticoagulants: brodifacoum, bromadiolone, difenacoum, and difethialone (none of which is registered for use against deer mice); and
- Nonanticoagulants: bromethalin, cholecalciferol, and zinc phosphide (the latter being the only one registered for use against deer mice).

Anticoagulants, when used as active ingredients in rodenticides, prevent blood from clotting and cause death as a result of internal bleeding. First-generation anticoagulants usually require multiple feedings over several days to acquire a lethal dose, so they are less likely to injure pets and nontarget wildlife than most other rodenticides.

Second-generation anticoagulants have the same mode of action as first-generation anticoagulants but are substantially more toxic. In some species, they are fatal after only a single feeding. Even after death, anticoagulants can be stored in the tissues of the target animal. Because second-generation anticoagulants are highly toxic and remain active much longer in animal tissues, they aren't registered for use against deer mice.

Zinc phosphide is the only nonanticoagulant rodenticide registered for use against deer mice. Zinc phosphide produces phosphine gas in the stomach of the mouse after ingestion. Because phosphine gas is highly lethal to all animals, it kills after a single feeding.

Rodenticides can poison nontarget animals (e.g., pets, domestic animals, and wildlife) either by direct consumption of toxic baits (primary exposure) or consumption of dead or dying rodents that have ingested toxic baits (secondary exposure). When using any rodenticide, follow label directions and take care to prevent accidental poisonings. Such risks can be reduced by exposing baits only within tamper-resistant bait stations and by locating and properly disposing of carcasses of poisoned rodents.

Controlling deer mice in residential settings. Although rodenticides are available for retail purchase to control house mice and rats, there are no toxic baits registered for controlling deer mice in residential settings. It is a violation of the product label to use rodent baits labeled for use "*only* against house mice, Norway rats, and roof rats" in an attempt to control deer mice. Instead, residential deer mouse control should be accomplished by using traps, excluding mice from structures, and modifying the habitat to remove sources of food and shelter.

If the deer mouse infestation is rather large and implementing effective control seems too daunting a task, consider hiring a professional licensed pest control operator with experience in rodent control.

Controlling deer mice in agricultural settings. Rodenticides containing first-generation anticoagulants are now restricted-use materials in agricultural fields and many noncrop settings, so only certified applicators can apply these materials. Broadcast applications of some first-generation anticoagulant baits (e.g., California Department of Food and Agriculture 0.01% chlorophacinone or 0.01% diphacinone-treated oats) are allowable for deer mouse control in specific agricultural and noncrop settings (e.g., dormant season applications in orchards and vineyards, roadsides, and ditch banks), although the label must be consulted to verify the legality and timing of their use for each situation.

Some rodenticide products containing first-generation anticoagulants can be used in and around agricultural buildings such as livestock rearing facilities and dairies, when specified on the product's label. Therefore, labels must be carefully consulted to verify the legality of using any product for deer mouse control. Applying first-generation anticoagulants inside such buildings may require a bait station if exposure to children, pets, or other nontarget animals is possible. Additionally, bait stations are required for all outdoor applications of rodenticide baits within 50 feet of any agricultural building. All residential use of agricultural baits is prohibited.

Some rodenticides containing zinc phosphide are currently registered for use against deer mice in agricultural fields in California, although applications are primarily limited to orchards, groves, and vineyards. Because zinc phosphide baits sometimes aren't well accepted by rodents, resulting in problems of bait shyness, and because hazards to nontarget species can sometimes occur, zinc phosphide baits should be used only by experienced applicators and in strict accordance with label directions.

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