

RATS

Integrated Pest Management for Home Gardeners and Landscape Professionals

Rats are some of the most troublesome and damaging rodents in the United States. They eat and contaminate food, damage structures and property, and transmit parasites and diseases to other animals and humans. Rats live and thrive in a wide variety of climates and conditions and are often found in and around homes and other buildings, on farms, and in gardens and open fields.



Figure 1. Adult roof rat.



Figure 2. Norway rat.

IDENTIFICATION

People don't often see rats, but signs of their presence are easy to detect. (See the sidebar How to Spot a Rat Infestation.) In California, the most troublesome rats are two introduced species, the roof rat (Fig. 1) and the Norway rat (Fig. 2). It's important to know which species of rat is present in order to choose effective control strategies.

Norway rats, *Rattus norvegicus*, sometimes called brown or sewer rats, are stocky burrowing rodents that are larger than roof rats. Their burrows are found along building foundations, beneath rubbish or woodpiles, and in moist areas in and around gardens and fields (Fig. 3). Nests can be lined with shredded paper, cloth, or other fibrous material. When Norway rats invade buildings, they usually remain in the basement or ground floor. Norway rats live throughout the 48 contiguous United States. While generally found at lower elevations, this species can occur wherever people live.

Roof rats, *R. rattus*, sometimes called black rats, are slightly smaller than Norway rats. Unlike Norway rats, their tails are longer than their heads and bodies combined. Roof rats are agile climbers and usually live and nest above ground in shrubs, trees, and dense vegetation such as ivy. In buildings, they are most often found

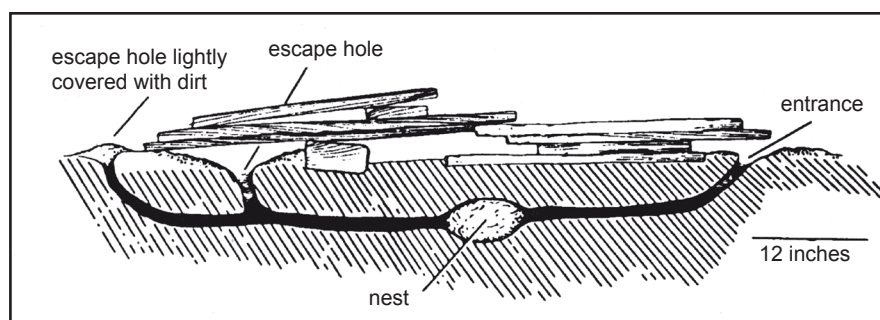


Figure 3. Norway rat burrow beneath a pile of boards.

HOW TO SPOT A RAT INFESTATION

Because rats are active throughout the year, periodically check for signs of their presence. Once rats have invaded your garden or landscape, unless your house is truly rodent proof, it is only a matter of time before you find evidence of them indoors. Experience has shown it's less time consuming to control rodents before their numbers get too high, and fewer traps and less bait will be required if control is started early.

Inspect your yard and home thoroughly. If the answer to any of the following questions is yes, you might have a rat problem.

- Do you find rat droppings around dog or cat dishes or pet food storage containers?
- Do you hear noises coming from the attic just after dusk?
- Have you found remnants of rat nests when dismantling your firewood stack?
- Does your dog or cat bring home dead rat carcasses?
- Is there evidence rodents are feeding on fruit or nuts that are in or falling from the trees in your yard?
- Do you see burrows among plants or damaged vegetables when working in the garden?
- Do you see rats traveling along utility lines or on the tops of fences at dusk or soon after?
- Have you found rat nests behind boxes or in drawers in the garage?
- Are there smudge marks caused by the rats rubbing their fur against beams, rafters, pipes, or walls?
- Do you see burrows beneath your compost pile or beneath the garbage can?
- Are there rat or mouse droppings in your recycle bins?
- Have you ever had to remove a drowned rat from your swimming pool or hot tub?
- Do you see evidence of something digging under your garden tool shed or doghouse?

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in enclosed or elevated spaces such as attics, walls, false ceilings, and cabinets. The roof rat has a more limited geographical range (Fig. 4) than the Norway rat, preferring ocean-influenced, warmer climates. In areas where the roof rat occurs, the Norway rat might also be present. If you are unsure of the species, look for rats at night with a bright flashlight, or trap a few. Figure 5 illustrates some of the key physical differences between the two species of rats, while Table 1 summarizes identifying characteristics.

While rats are much larger than the common house mouse or meadow vole, a young rat is occasionally confused with a mouse. In general, very young rats have large heads and feet in proportion to their bodies, whereas those of adult mice are proportionately much smaller (Fig. 6). While both rats and mice gnaw on wood, rats leave much larger tooth marks than mice do. For additional information on mice, see *Pest Notes: House Mouse* and *Pest Notes: Voles (Meadow Mice)* listed in References.

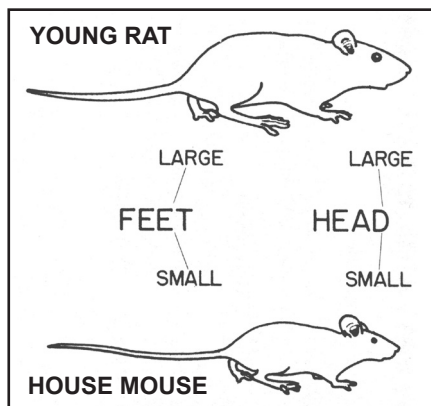


Figure 6. Key differences between a young rat (above) and mouse (below).

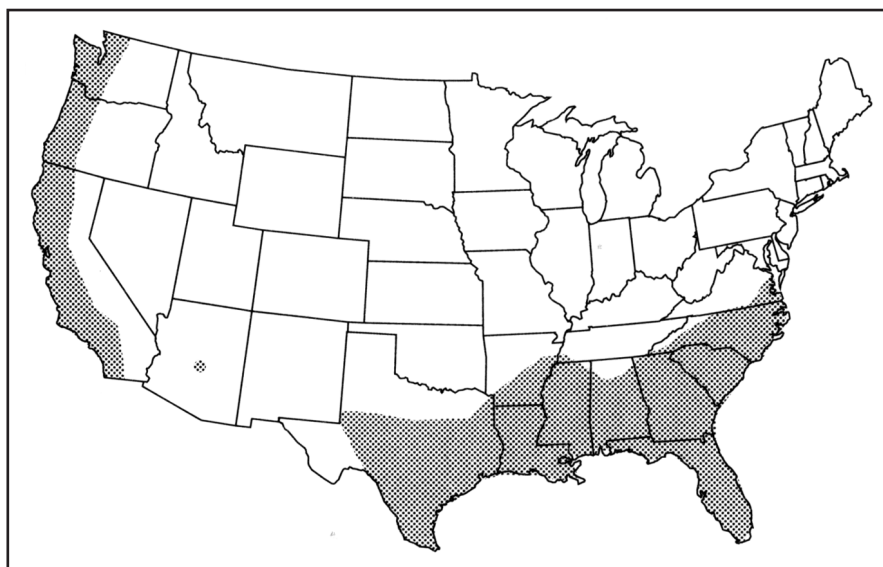


Figure 4. Distribution of roof rats in the contiguous United States.

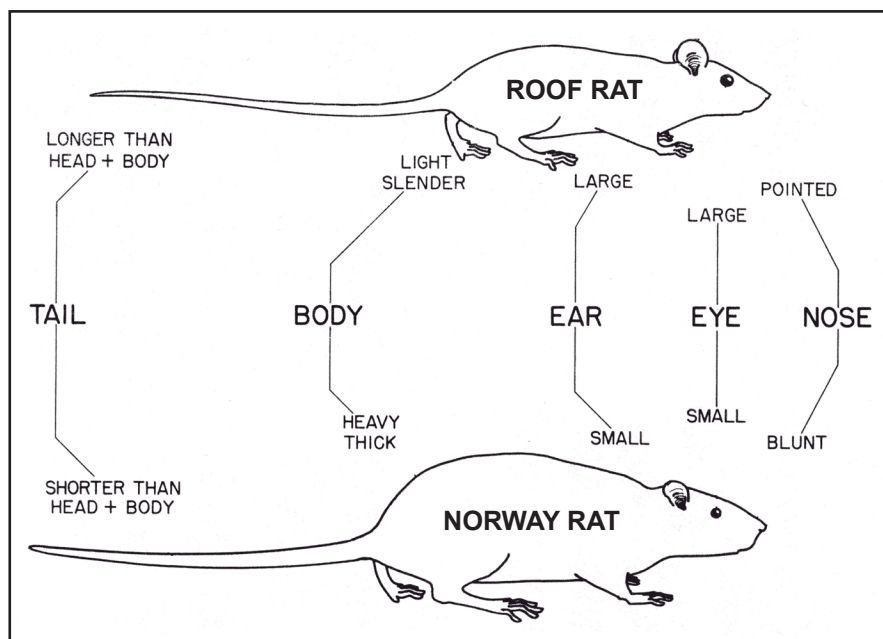


Figure 5. Key characteristics between roof rats (above) and Norway rats (below).

Table 1.

Identifying Characteristics of Adult Rats.

Characteristic	Roof rat	Norway rat
general appearance	sleek, agile	large, robust
color of belly	gray to white	mostly gray
body weight	5 to 10 ounces	7 to 18 ounces
tail	extends at least to snout, uniformly dark with fine scales	shorter than body, dark above and pale below, scaly
head	pointed muzzle	blunt muzzle
ears	long enough to reach eyes if folded over	don't reach eyes

BIOLOGY AND LIFE CYCLE

Rats, like house mice, are active mostly at night. They have poor eyesight, but they make up for this with their keen senses of hearing, smell, taste, and touch. Rats constantly explore and learn, memorizing the locations of pathways, obstacles, food and water, shelter, and features of their environment. They quickly detect and tend to avoid new objects and novel foods. Thus, they often avoid traps and baits for several days or more following their initial placement. While both species exhibit this avoidance of new objects, this neophobia is usually more pronounced in roof rats than in Norway rats.

Both Norway and roof rats can gain entry to structures by gnawing, climbing, jumping, or swimming through sewers and entering through toilets or broken drains. While Norway rats are more powerful swimmers, roof rats are more agile and are better climbers.

Norway and roof rats don't get along. The Norway rat is larger and the more dominant species; it will kill a roof rat in a fight. When the two species occupy the same building, Norway rats may dominate the basement and ground floors, with roof rats occupying the attic or second and third floors. Contrary to some conceptions, the two species can't interbreed. Both species can share some of the same food resources but don't feed side by side. Rats can grab food and carry it off to feed elsewhere.

Rats of either species, especially young rats, can squeeze beneath a door with only a 1/2-inch gap. If the door is made of wood, the rat might gnaw to enlarge the gap, but this might not be necessary.

Norway Rats

Norway rats eat a wide variety of foods but mostly prefer cereal grains, meats, fish, nuts, and some fruits. 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 average female Norway rat has 4 to 6 litters per year and can successfully wean 20 or more offspring annually.

Roof Rats

Like Norway rats, roof rats eat a wide variety of foods, but they prefer fruits, nuts, berries, slugs, and snails. Roof rats are especially fond of avocados and citrus, and they often eat fruit that is still on the tree. When feeding on a mature orange, they make a small hole through which they completely remove the contents of the fruit, leaving only the hollowed-out rind hanging on the tree. They'll often eat the rind of a lemon, leaving the flesh of the sour fruit still hanging. Their favorite habitats are attics, trees, and overgrown shrubbery or vines. Residential or industrial areas with mature landscaping provide good habitat as does riparian vegetation of riverbanks and streams. Roof rats prefer to nest in locations off the ground and rarely dig burrows for living quarters if off-the-ground sites exist.

Roof rats routinely travel up to 300 feet for food. They can live in the landscaping of one residence and feed at another. They often can be seen at night running along overhead utility lines or fence tops. They have an excellent sense of balance and use their long tails to steady themselves while traveling along overhead utility lines. They move faster than Norway rats and are very agile climbers, which enables them to quickly escape predators. They can live in trees or in attics and climb down to a food source. The average number of litters a female roof rat has per year depends on many factors, but generally it is 3 to 5 with 5 to 8 young in each litter.

DAMAGE

Rats eat and contaminate foodstuffs and animal feed. They also damage containers and packaging materials in which foods and feed are stored. Both rat species cause problems by gnawing on electrical wires and wooden structures such as doors, ledges,

corners, and wall material, and they tear up insulation in walls and ceilings for nesting.

Norway rats can undermine building foundations and slabs with their burrowing activities and can gnaw on all types of materials, including soft metals such as copper and lead, as well as plastic and wood. If roof rats are living in the attic of a residence, they can cause considerable damage with their gnawing and nest-building activities. They also damage garden crops and ornamental plantings.

Among the diseases rats can transmit to humans or livestock are murine typhus, leptospirosis, salmonellosis (food poisoning), and ratbite fever. Plague is a disease that both roof and Norway rats can carry, but in California it is more commonly associated with ground squirrels, chipmunks, and native woodrats.

MANAGEMENT

A successful rat control strategy typically includes three elements: sanitation measures; building construction and rodent proofing; and, if necessary, population control.

Sanitation

Sanitation is fundamental to rat control and must be continuous. If sanitation measures aren't properly maintained, the benefits of other measures will be lost and rats will quickly return. Good housekeeping in and around buildings will reduce available shelter and food sources for Norway rats and, to some extent, roof rats. Neat, off-the-ground storage of pipes, lumber, firewood, crates, boxes, gardening equipment, and other household goods will help reduce the suitability of the area for rats and also will make their detection easier. Collect garbage, trash, and garden debris frequently, and ensure all garbage receptacles have tight-fitting covers. Where dogs are kept and fed outdoors, rats can become a problem if there is a ready supply of dog food. Feed your pet only the amount of food it will eat at a feeding, and store pet food in rodent-proof containers.

For roof rats in particular, thinning dense vegetation will make the habitat less desirable. Climbing hedges such as Algerian or English ivy, star jasmine, and honeysuckle on fences or buildings are conducive to roof rat infestations and should be thinned or removed if possible, as should overhanging tree limbs within 3 feet of the roof. Separate the canopy of densely growing plants such as pyracantha and juniper from one another and from buildings by a distance of 2 feet or more to make it more difficult for rats to move between them.

Building Construction and Rodent Proofing

The most successful and long-lasting form of rat control in structures is exclusion, or “building them out.” (See the sidebar Rodent Proofing Your Home.) 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 1/4 inch should be left unsealed, in order to exclude both rats and house mice. Make sure doors, windows, and screens fit tightly. Their edges can be covered with sheet metal if gnawing is a problem. Coarse steel wool, wire screen, and lightweight sheet metal are excellent materials for plugging gaps and holes. Norway and roof rats are likely to gnaw away plastic sheeting, wood, caulking, and other less sturdy materials.

Because rats and house mice are excellent climbers, openings above ground level must also be plugged. Rodent proofing against roof rats, because of their greater climbing ability, usually requires more time to find entry points than for Norway rats. Roof rats often enter buildings at the roofline, so be sure that all access points in the roof are sealed. If roof rats are traveling on overhead utility wires, contact a pest control professional or the utility company for information and assistance with measures that can be taken to prevent this.

RODENT PROOFING YOUR HOME

- Repair or replace damaged ventilation screen around the foundation and under the eaves.
- Provide a tight-fitting cover for the crawl space.
- Seal all openings around pipes, cables, and wires that enter through walls or the foundation.
- Be sure all windows that can be opened are screened and that the screens are in good condition.
- Cover all chimneys with a spark arrester.
- Make sure internal screens on roof and attic air vents are in good repair.
- Cover rooftop plumbing vent pipes in excess of 2 inches in diameter with screens over their tops.
- Make sure all exterior doors are tight fitting and weatherproofed at the bottom.
- Seal gaps beneath garage doors with a gasket or weather stripping.
- Install self-closing exits to clothes dryer vents to the outside.
- Remember that pet doors into the house or garage provide an easy entrance for rodents.
- Keep side doors to the garage closed, especially at night.

Population Control

When food, water, and shelter are available, rat populations can increase quickly. While the most permanent form of control is to limit food, water, shelter, and access to buildings, direct population control often is necessary.

For controlling rats indoors, using traps is best. When rodenticides (toxic baits) are used in structures, rats can die in inaccessible locations such as within walls or ceilings. In hot weather, the stench of a dead rat can be unbearable and can necessitate cutting a hole in the wall to remove the carcass. Also, ectoparasites such as fleas and mites often leave dead rat carcasses and can infest the entire house if the carcass isn't removed promptly.

Trapping. Trapping is the safest and most effective method for controlling rats in and around homes, garages, and other structures. Because snap traps can be used over and over, trapping is less costly than poison baits but more labor intensive. Traps can be set and left indefinitely in areas such as attics where rats have been a problem in the past. The simple, wooden rat-size snap trap is the least expensive option, but some people prefer the newer plastic, single-kill rat traps, because they are easier to set and to 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. Generally, young rats can't be trapped until they are about a month old, which is when they leave the nest to venture out for food.

Nutmeats, dried fruit, bacon, or a piece of kibbled pet food can be an attractive bait for traps. Fasten the bait securely to the trigger of the trap with light string, thread, or fine wire so the rodent will spring the trap when attempting to remove the food. Even glue can be used to secure the bait to the trigger. Soft baits such as peanut butter and cheese can be used, but rats sometimes take soft baits without setting off the trap. Set traps so the trigger is sensitive and will spring easily.

The best places to set traps are in secluded areas where rats are likely to travel and seek shelter. Droppings, gnawings, and damage indicate the presence of rodents, and areas where such evidence is found usually are the best places to set traps, especially when these areas are located between their shelter and food sources. Place traps in natural travel ways, such as along walls, so the rodents will pass directly over the trigger of the trap.

For *Norway rats*, set traps close to walls, behind objects, in dark corners, and in places where rat signs, such as droppings, have been seen. Position traps along a wall so that they extend from the wall at right angles, with the

trigger end nearly touching the wall (Fig. 7). If traps are set parallel to the wall, they should be set in pairs to intercept rodents traveling from either direction.

For *roof rats*, the best places for traps are off the ground in locations where rats might be coming down from their nests to find food—such as on ledges, shelves, branches, fences, pipes, or overhead beams—where they can be fastened with screws or wire (Fig. 8). In homes, the attic and garage rafters close to the infestation are good trapping sites (Fig. 9). In areas where children, pets, or birds might contact traps, place the trap in a box or use a barrier to keep them away.

Use as many traps as are practical so trapping time will be short and decisive. A dozen or more traps for a heavily infested home might be necessary. Place rat traps about 10 to 20 feet apart. If a rat sets off a trap without getting caught, it will be very difficult to catch the rat with a trap again. To reduce the likelihood of “trap shyness,” one strategy is to leave traps baited but unset until the bait has been taken overnight. To avoid using too few traps, if bait is taken from all traps, double the number of baited traps exposed, and keep doing so until some traps remain with bait untaken; then bait and set all traps.

Electrocution Traps. Traps that kill rats by electrocution (e.g., Rat Zapper or Victor Electronic traps) are considerably more expensive than other traps, but some homeowners, managers of commercial buildings, and pest control companies have found them to provide good results. As with snap traps, for existing rodent populations it’s important to use enough traps to achieve control in a timely manner. These traps need to be checked frequently, and dead rodents should be removed for disposal.

Don’t touch rodents with your bare hands, and wash thoroughly after handling traps. Use disposable gloves to handle dead rodents. Dispose of dead rats by burying them or by placing them in a sealed plastic bag and putting them in the trash.

Glue Boards. Glue traps, which work on the same principle as flypaper, aren’t recommended for controlling rats, as they are much less effective for rats than for mice. A major drawback with glue boards and other live-catch traps is the trapped rat 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. Rats caught in glue traps can struggle for quite some time, often dragging the trap as they try to escape. When used indoors, cats and dogs can get into the glue and track it around the house; outdoors, glue traps can capture lizards, birds, and other nontarget wildlife.

Live Traps. Live traps aren’t preferred, because trapped rats must be either humanely killed or released elsewhere. Releasing rats outdoors isn’t recommended, as they can cause health concerns to people, pets, and other domestic animals. Because neither the roof rat nor the Norway rat is native to the United States, their presence in the wild is very detrimental to native ecosystems. They have been known to decimate some bird populations.

Rodenticides (Toxic Baits)

While trapping is generally recommended for controlling rats indoors, when the number of rats around a building is high, you might need to use toxic baits to achieve adequate control, especially if there is a continuous reinfestation from surrounding areas. If this is the case, consider hiring a licensed pest control applicator who is trained to use rodenticides safely.

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 to reduce accidental exposure to children. These federal EPA restrictions now permit manufacturers to produce, for sale to the general public, only wax block, gel, or paste rat and mouse baits

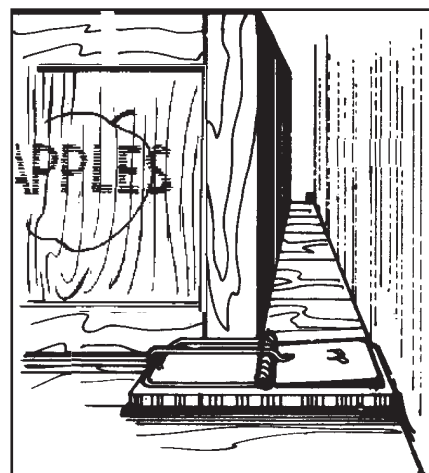


Figure 7. Set traps along walls so rodents pass over the treadle. A box or board placed in advantage can guide the rat into the trap.

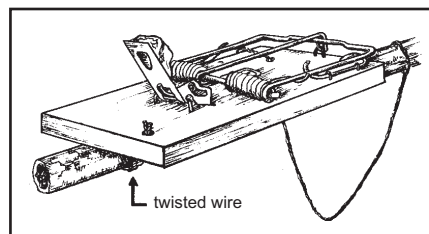


Figure 8. Setting a trap on an overhead pipe. To support the trap, drill a hole in the trap base near the trigger or treadle and twist a wire around the pipe, leaving a short, upstanding end. The hole in the trap is put over the wire end. A soft wire from the other end of the trap is fastened to an object below the runway. When sprung, the trap and rat will bounce off and hang from the wire, leaving the runway free for other rats to find other traps.

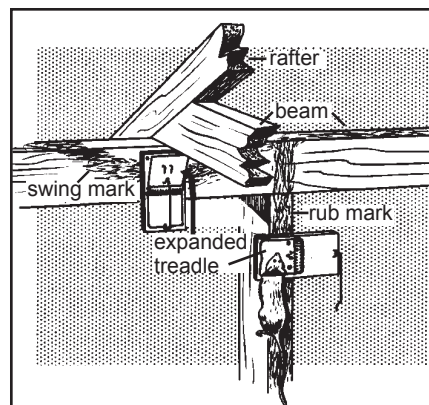


Figure 9. Overhead traps are particularly useful for roof rats. Purchase traps with an expanded treadle and fasten them to beams or studs with screws or wires so the treadle is directly in the pathway of the rat.

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 for several days, 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 control when baits are fresh and when placed in suitable locations so as to attract rats.

The various anticoagulant active ingredients currently registered for use against rats in California are listed in Table 2. Anticoagulants fall into two groups—the older “first-generation” compounds such as warfarin, chlorophacinone, and diphacinone, which require a rodent to consume multiple doses over a period of several days; and the newer “second-generation” compounds such as brodifacoum, bromadiolone, difenacoum, and difethialone, which can be fatal after a single feeding. Since not all 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.

The recommended strategy of bait application, which is often needed for optimum rodent control, can result in a rodent ingesting an overdose of

Table 2.

Anticoagulant Rodenticides for Rat 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, Contrac, 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.

Table 3.

Other Rodenticides for Rat 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.

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 and household pets, 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 by only by agricultural producers 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 with larger animals generally requiring a larger dose of toxicant than 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, whole blood transfusion is also used. (See the sidebar Pets and Rat Control.)

Other Rodenticides. Three other active ingredients are registered and used as rodenticides to control rats and house mice in California: bromethalin, cholecalciferol, and zinc phosphide. (See Table 3.) 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 rats will have the opportunity to feed on exposed baits one or more times over a 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 rodent within several hours after a lethal dose is ingested. Because zinc phosphide baits often require prebaiting to get adequate bait acceptance (offering rats similar but nontoxic bait before applying the zinc phosphide bait), it's not commonly used against rats and is infrequently available to consumers. An advantage of zinc phosphide bait is its ability to achieve a comparatively quick reduction of a rat population, and for this reason pest control personnel and agricultural producers sometimes favor it.

While risk of secondary poisoning to predators and scavengers is low because of the mode of action of these three rodenticides, a primary hazard to nontarget animals (i.e., 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. Some baits must be contained within bait stations for all outdoor, above-ground applications (Fig. 10). In addition to increasing the safety of the bait, bait stations also help the rats feel secure while feeding. Place all bait stations in rat travel ways or near their

PETS AND RAT CONTROL

Many of the methods and materials used to control rats can affect pets as well. All rodent baits are toxic to dogs and cats, so be cautious when using these products. Because anticoagulants are cumulative and slow acting to various degrees, depending on whether it is multiple or single feeding, dead rats can contain several lethal doses of toxicant, and secondary poisoning of pets and wildlife is possible if they eat several rat carcasses over a few days. While this secondary poisoning is possible, it isn't common with the first-generation anticoagulants. Most fatalities in pets involve dogs and are due to the animal eating the bait directly (primary poisoning) or a combination of direct bait consumption and secondary poisoning. Concerns about both primary and second hazards of second-generation anticoagulant baits led the EPA to restrict their retail sale in mid-2011, making them available only to agricultural users and professional pest control personnel. When such baits are in use, extra caution is needed, as exposure to even a single dead rodent might be enough to poison a pet.

The best precaution is to keep pets away from bait and dead or dying rodents. Dispose of dead rodents by burying them or by placing them in a sealed plastic bag and putting them in the trash. Do not handle them with bare hands. Read all label directions on the bait and place it only in areas that are specified on the label. Put bait in locations out of the reach of children, pets, domestic animals, and nontarget wildlife or in tamper-resistant bait stations as required by the product label. In many cases, bait stations must be resistant to destruction by dogs and by children younger than 6 years old and must be constructed in a manner that prevents a child from reaching into the bait compartments and getting the 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. Clearly label all bait stations with appropriate warnings, and store unused bait in a locked cabinet or another area inaccessible to children and domestic animals.

burrows and harborage. Don't expect rats to go out of their way to find the bait. For Norway rats, place bait stations near rodent burrows or suspected nest sites, against walls, or along travel routes. For roof rats, place baits in elevated locations, such as in the crotch of a tree, on top of a fence, or high in a vine. If you place bait stations above ground level, take care that they are securely fastened and won't fall to the ground where children or pets could find them. Because rats often are suspicious of new or unfamiliar objects, it might take several days for them to enter and feed in bait stations.

Where it is impossible to exclude rodents from structures, rat 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 rats before populations become established. For best results, make sure there is a continuous supply of bait until feeding stops. With the first-generation anticoagulant baits, it usually takes 5 or more days, once the rats start feeding, for them to die. Check bait stations regularly and replace bait if it gets old or moldy, because rats won't eat stale bait.

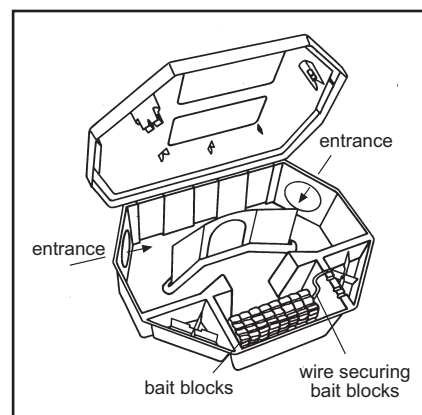


Figure 10. A commercially made, tamper-resistant bait station made for rats. Entrances also will permit house mice to enter and feed. All baits placed in outdoor locations for rats and mice must be contained within approved, tamper-proof bait stations.

Baits and bait stations 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.” 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 outdoors. Other baits or bait stations may also be used around the periphery of structures or within 50 feet of a structure. Because rats may not travel far from their shelter to find food, many product labels suggest making bait placements at 10- to 30-foot intervals. Place bait boxes next to walls (with the openings close to the wall) or in other places where rats 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, seal them in the bag for disposal with household garbage, or bury them in a location where pets or scavengers won't easily dig them up.

Other Control Methods

Rats are wary animals, easily frightened by unfamiliar or strange noises. However, they quickly become accustomed to repeated sounds, making the use of frightening devices—including high frequency and ultrasonic sounds—ineffective for controlling rats in homes and gardens.

Rats have an initial aversion to some odors and tastes, but no repellents have been found to solve a rat problem for more than a very short time. There are no truly effective rat repellents registered for use in California.

Smoke or gas cartridges are registered and sold for controlling burrowing rodents. When placed into the burrows and ignited, these cartridges produce toxic and suffocating smoke and gases. Because Norway rat burrows can extend beneath a residence and have several open entrances, toxic gases

can permeate the dwelling. For this reason and because some fire hazard is associated with their use, smoke and gas cartridges aren't recommended for rat control around homes.

Norway rats can be drowned or flushed from their burrows by flooding them with water from a garden hose and then closing the holes with soil.

Predators, especially cats and owls, eat rats and mice. Some house cats don't have the ability or inclination to prey on adult Norway rats. Often, predators aren't able to keep rodent numbers below levels that are acceptable to most people. Further, pet food can serve as an attractant and provide a continuous food supply to rats and mice in suburban environments.

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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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