

Mammal Pests

Introduction

This section contains methods used to control field rodents and rabbits and is a guide for agricultural commissioner personnel engaged in this work. Most pest mammals are discussed with specific control options. Rodenticides are often recommended. Before rodenticides are used, acceptance tests should be made to indicate the degree of bait acceptance that can be expected. If bait acceptance is good, most of the bait will be quickly consumed by rodents during a 24-hour period. If acceptance is poor, toxic bait should not be used. Too frequent application of acute toxic baits, like zinc phosphide, may cause bait and poison shyness. Unlike insecticides, which are generally applied to the crop itself, rodent baits are commonly placed in rodent burrows or applied to trails or areas where rodents naturally feed. Rodent baits should not be applied in any manner that will contaminate food or feed crops. This would include any application method which would cause the bait to lodge in food plants. Fumigants are applied directly into the rodent burrow and are sealed in by covering the burrow opening with a shovelful of dirt.

Identifying Rodents Causing Damage to Crops

One of the keys to controlling rodent damage in crops is prompt and accurate determination of which species is causing the damage. To make a positive species identification, survey the area of reported damage and look for signs of rodent activity such as: trails, runs, tracks and tail marks, droppings, burrows, nests and food caches. Also look for cuttings of grass or plant material in trails, runs or near burrow entrances. If trees or shrubs are being girdled note the size of the tooth marks and location of damage. The size of the incisor marks and location of damage may assist in identifying the rodent.

Snap traps of an appropriate size are one method used to identify the smaller rodent species damaging a crop. Traps can also assist in determining population densities, obtaining reproductive data, and censoring a rodent population in an area before and after a control program to evaluate the control results. Trap line procedures used in crops are discussed below.

Trapping Precautions

This section is based on the document Hantavirus Infection - California: Recommendations for Risk Reduction (Division of Communicable Disease Control, California Department of Health Services, August 20, 1993) and the report Hantavirus Infection - Southwest: Recommendations for Risk Reduction (CDC, MMWR July 30, 1993;Vol. 42:No. RR-11). Further detailed information is obtainable at the [Center for Disease Control](#).

Wild rodents can be reservoir hosts of diseases transmissible to humans, including a frequently lethal strain of Hantavirus. Precautions should be taken when trapping small rodents. If possible, snap (kill) trap methods should be employed. Protective clothing should be worn while trapping, including rubber or plastic gloves and coveralls (or other work clothing). Never eat, drink, or smoke while trapping. Wear insect repellent, as necessary, in areas with mosquito, flea, and tick problems. Before removing a rodent carcass from a trap, spray the carcass and trap with a general-purpose household disinfectant. Soak the carcass thoroughly and then place it in a plastic bag. To do this, pick-up the carcass and remove it from the

trap using an inverted plastic bag; place the carcass and bag into a second bag and seal. Dispose of the double bagged carcass as permitted by local regulations. Clean traps, surfaces, or other materials that have been contaminated in disinfectant before reusing. Remove gloves and dispose of these in the trash; thoroughly wash hands with soap and water.

If live trapping of rodents is necessary, special precautions should be considered. Persons involved with extensive handling of rodents should have a baseline serum sample drawn (store at -20°C), preferably at the time of employment. Workers who develop a febrile or respiratory illness within 45 days of the last exposure should seek medical attention immediately and inform the attending physician of the potential occupational risk of rodent-borne infection (e.g., hantavirus pulmonary syndrome, plague, etc.). In addition to the protective measures described for snap trapping, workers should wear a half-mask air-purifying (or negative-pressure) respirator with a high-efficiency particulate air (HEPA) filter or a powered air-purifying respirator (PAPR) with HEPA filters when handling live rodents, including removing them from traps. Respirators (including positive-pressure types) are not considered protective if facial hair interferes with the face seal, since proper fit cannot be assured. Respirator practices should follow a comprehensive user program, be supervised by a knowledgeable person, and be in compliance with Cal/OSHA regulations.

MEADOW VOLES, DEER MICE, HOUSE MICE.

Snap-trapping enables an individual to detect or confirm the presence of mice in crops or adjacent uncultivated grassy area. One hundred baited (wet oatmeal or peanut butter) mouse snap-traps are set approximately 10 feet apart in a transect line across the area to be sampled. The traps are set at locations which will increase likelihood of success (runways or burrows) and are serviced and reset daily for two or three days. Traps should be set at right angles to runways or burrow openings to increase the frequency of catch. The number of mice caught per 100-trap-nights will serve as a population index. A 10% mouse catch per 100-trap-nights provides evidence that some type of control action should be considered. In some situations, action may be implemented when fewer mice are present depending on their propensity for increasing in numbers and causing damage.

NORWAY RATS

Fifty rat traps baited with peanut butter or nut meats, are set approximately 20 feet apart in a transect line across the area to be sampled. In crops such as rice, corn, or melons, traps may be set along drainage canals or roadside areas. Trap placement should be in locations which will increase likelihood of success (runways or burrows) and are serviced and reset daily for two or three days. Frequency of trap catch is greater when traps are set at right angles to the runways. The numbers of rats caught per 50-trap-nights will serve as a population index.

ROOF RATS, NORWAY RATS, WOOD RATS.

Citrus, avocados, olives and nuts are tree crops that may be damaged by rats. It is important to identify the species of rat causing the problem prior to control actions. Set rat traps baited with fruit or nut meats in pairs at the base of each tree suspected of being damaged. If damage is occurring in trees or vines, set traps in these areas as well.

The roof rat is somewhat smaller than the Norway rat. The body is slender and the snout is pointed. The roof rat has a tail longer than its body and head combined, and its ears are large and prominent. The larger Norway rat has a heavyset body with a blunt snout. The tail is shorter than the body and head combined,

and the ears are small and close set.

Tree crop damage may occasionally be caused by native wood rats. Although size and body shape may vary among the many species in western North America, wood rats generally have a bushy or tufted tail and the underparts and feet are lighter than the upper body.

Safety Precautions for Rodenticide Use

The safe handling, storage and use of rodenticides is the responsibility of the applicator. The applicator shall follow all label instructions at all times.

1. All bags, sacks or other containers should have the product label attached. All containers of bait other than the original labeled container (service container) shall be labeled with the precautionary statement that applies (i.e. danger, warning or caution), the name of the toxicant and name and address of responsible party. This includes bait stations.
2. Toxic baits and concentrates shall be stored in an adequately locked space at all times when not in use. Such space shall be entirely separate from where food or drink for humans or domestic animals is kept stored.
3. All persons handling toxic baits or concentrates should be advised as to:
 - The characteristics of these materials.
 - The necessity of using adequate protective clothing and devices such as gloves and/or bait spoons for dispensing baits.
 - The necessity for keeping all skin abrasions and cuts adequately protected.
 - The possibility of inadvertent poisoning of wildlife and domestic animals by improper bait exposure.
 - The symptoms of poisoning and recommended first aid if such symptoms occur.
4. To prevent the accidental bait spillage, containers should be so designed and in such repair that leakage or spillage does not occur.
5. Toxic bait accidentally spilled should be immediately and thoroughly cleaned up.
6. Do not leave containers of bait unattended or where it can be obtained by children, irresponsible persons or animals.
7. Unused bait should be disposed of according to label directions.
8. Dispose of empty bait containers according to label directions.
9. Wash hands with soap and water after handling poison baits and before eating or smoking.

Guidelines for Baiting Field Rodents

Pre-Treatment

1. Annual rodent control plans shall be reviewed by the California Department of Fish and Game regarding hazards to threatened and endangered species as specified in the "Joint Policy Statement of the California Department of Food and Agriculture, California Department of Fish and Game and the California Agricultural Commissioners Association Regarding Threatened and Endangered Species."
2. Actual damage or threat of damage must be sufficient to warrant application of rodent baits. As a safeguard to humans and domestic animals, alternative methods such as fumigants or anticoagulant baits in bait stations should be considered around inhabited buildings, suburban areas and domestic animals.
3. Baiting should not be done unless tests indicate satisfactory bait acceptance occurs in areas to be treated.
4. Bait should be chosen on the basis of selectivity as well as acceptance value.
5. When county agricultural commissioners anticipate control programs involving other than established practices the California Department of Food and Agriculture should be advised.

Treatment

1. The county agricultural commissioner or his staff should be aware of the conditions at the site of application and in a position to direct and control the manner in which the application is made.
2. Toxic baits used in control operations shall be artificially colored or dyed.
3. Quantities of toxic bait exposed shall be regulated so that residual bait will be low to minimize a hazard to nontarget species.
4. Property owners or tenants shall be advised to dispose of rodent carcasses on the ground surface immediately adjacent to inhabited areas. A shovel should be used to minimize possible contact with ectoparasites and diseases.
5. There are no specific statutory provisions requiring the posting of warning signs for rodent control. However, when premises are posted in accordance with county policy, they are to be posted as prescribed by the California Penal Code, Section 596 - ("signs located at intervals of distance not greater than one-third of a mile apart and in any case not less than three such signs having words with letters at least one inch high reading "WARNING - POISON BAIT PLACED OUT ON THESE PREMISES").
6. All accidentally spilled grain bait shall be cleaned up immediately.
7. Discarded or used containers shall be disposed of in accordance with California laws and regulations pertaining to disposal of pesticide containers.

Post-Treatment

An annual written evaluation should be made of representative areas describing the degree of control and any observed effects on nontarget wildlife.

Guidelines for Applying Rodent Baits by Aircraft

FOR CONTROL OF GROUND SQUIRRELS

Pre-Treatment

1. Actual damage or threat of damage should be sufficient to warrant aerial application of rodent baits. Alternative methods shall always be considered.
2. Conduct bait acceptance prior to treatment to ensure the squirrels will take the bait offered. Use untreated oats as the prebait acceptance material. No baiting should be implemented unless tests indicate satisfactory bait acceptance occurs in representative areas.
3. The pilot should be thoroughly familiar with the application site. Maps (topographic/aerial) identifying boundaries and sensitive areas shall be provided to the pilot prior to application. All licenses required for aerial application of bait should be current and in order – ([Pest Control Aircraft Pilot's Certificate](#)).
4. Property lines and boundaries must be identifiable from the air.
5. The aircraft shall be calibrated with nontoxic oats.
6. A written, general evaluation should be made of several representative areas describing damage or threat of damage, bait acceptance and the presence of nontarget wildlife which might be threatened by the treatment.

Treatment

1. Several people are necessary and required to monitor and manage the aerial application. One person should oversee bait handling and record keeping at the landing strip; another person should monitor the operation in each area under treatment.
2. As a rule of thumb, aerial baiting should not occur on the same parcel of land more often than once every two years with the same toxicant.
3. Provisions shall be made to eliminate spillage of bait at the loading site. Unless automatic loading equipment is utilized, a ground cloth or canvas should be used.
4. No treatment should be made when wind velocity impairs effective bait placement.
5. No treatment should be made when fields are muddy, have standing water, or when rain is expected within 24 hours.
6. Treated bait should not be applied near farm buildings, or over domestic or livestock water supplies.
7. Ground-to-air communication should be in use during treatment.
8. The aircraft bait hopper should be:

- Thoroughly cleaned before the first baiting of the program, after final baiting of the program, and if baiting hopper has been used for other pesticides during the program.
 - Emptied of bait at the end of each day's operation and bait stored in locked container.
9. The rate of application shall be monitored daily by measuring bait dispersal in the treated areas.
 10. All accidentally spilled grain bait shall be cleaned up immediately.

Post-Treatment

A written evaluation should be made of representative areas describing the degree of control and any observed effects on nontarget wildlife.

Guidelines for Applying Rodent Baits by Aircraft

FOR CONTROL OF MEADOW VOLES

Pre-Treatment

1. Actual damage or threat of damage must be sufficient to warrant aerial application of rodent baits. Damage may be substantiated by snap traps. Normally a 10% meadow mouse catch per 100 trap nights warrants control of the mouse population. Alternative methods shall always be considered.
2. No baiting should be implemented unless tests indicate satisfactory bait acceptance occurs in representative areas.
3. The pilot should be thoroughly familiar with the property(ies) to be treated.
4. The aircraft should be calibrated with nontoxic baits under the supervision of the agricultural commissioner or his staff.
5. A written general evaluation shall be made of several representative areas describing damage or threat of damage, bait acceptance and the presence of nontarget wildlife.

Treatment

1. Provisions shall be made to eliminate spillage of bait at the loading site. Unless automatic loading equipment is utilized, a ground cloth or canvas should be used.
2. No treatment should be made when wind velocity impairs effective bait placement.
3. No treatment should be made when fields are muddy, have standing water, or when rain is expected within 24 hours.
4. Treated bait should not be applied near farm buildings or over water supplies.
5. An automatic flagman or a ground flagman should be used during treatment.
6. Ground-to-air communication should be in use during treatment.
7. The aircraft bait hopper should be:
 - Thoroughly cleaned before the first baiting of the program, after final baiting of the program, and during if hopper has been used for other pesticides during the program.
 - Emptied of bait at the end of each day's operation and bait stored in locked container.
8. The rate of application should be monitored daily by measuring bait dispersal in the treated area.

All accidentally spilled grain bait should be cleaned up immediately.

Post-Treatment

A written evaluation should be made of representative areas describing the degree of control and any observed effects on nontarget wildlife.

Guidelines for Applying Rodent Baits by Aircraft

FOR CONTROL OF FOREST RODENTS

Pre-Treatment

1. Actual damage or threat of damage must be sufficient to warrant aerial application of rodent baits.
2. No baiting should be implemented unless tests indicate satisfactory bait acceptance occurs in representative areas.
3. The pilot should be thoroughly familiar with the property(ies) to be treated.
4. The aircraft should be properly calibrated prior to bait application.
5. A written general evaluation should be made of representative areas describing damage or threat of damage, bait acceptance and presence of nontarget wildlife

Treatment

1. Helicopters are generally used rather than fixed wing aircraft for forest rodent control.
2. Provisions should be made to eliminate spillage of bait at the loading site. Unless automatic loading equipment is utilized, a ground cloth or canvas should be used.
3. No treatment should be made when wind velocity impairs effective bait placement.
4. Treated bait should not be applied near farm buildings or over water supplies.
5. The aircraft bait hopper should be:
 - Thoroughly cleaned before the first baiting of the program, after final baiting of the program, and if baiting hopper has been used for other pesticides during the program.
 - Emptied of bait at the end of each day's operation and bait stored in locked container.
6. The rate of application should be monitored occasionally by measuring bait dispersal in the treated area.
7. All accidentally spilled grain bait should be cleaned up immediately.

Post-Treatment

A good practice is to provide a written evaluation of representative areas describing the degree of control and any observed effects on nontarget wildlife for all application sites.

Calibration of Bait Broadcasting Equipment Including Aircraft

Calibration

Accurate calibration of aircraft or other broadcasters is essential for safe, successful and economical rodent control. Dispersing less than the actual amount of bait desired may lead to only partial control; conversely, rates higher than necessary are wasteful and may create unnecessary hazards.

The use of placebo bait, containing all the ingredients except the toxicant for calibration is recommended since clean grain and placebo bait may differ in rate of flow from certain hoppers. Toxic grain, because of the potential hazards, should never be used in calibration.

Two methods have been used to calibrate aircraft; the first (and more reliable) requires that a weighed amount (preferably 75 lbs. or more) of placebo bait be loaded in the hopper. With the gate pre-adjusted to the approximate opening, the pilot flies a swath one mile long at the speed and height to be used during the control operation. The grain bait remaining in the hopper is then weighed to determine the amount applied. The distance flown, multiplied by the swath width, can be converted to swath-acres, enabling the calculation of pounds per swath-acre. In the event the first trial fails to produce the desired rate, the gate must be readjusted and swath applied repeatedly until the proper rate is achieved.

Rate of application can also be determined by the average number of kernels of grain deposited per square foot. Then of course, the number of kernels per pound of bait must be known. To establish the number of kernels per square foot, a trial swath at least 100 yards in length is applied over a paved runway or other smooth surface. Individual square-foot counts are made with a steel tape (100 ft.) and a square-foot counting frame. The edges of the swath are determined by the presence of the furthest kernel found from the transect, ignoring the occasional kernel that may land way outside the general swath area. The tape is laid at right angles across the swath to determine the exact width and act as a guide baseline for counting the number of bait kernels per square foot. In practice, the counting frame is placed alongside the tape at the swath edge, the number of kernels within the frame are counted and recorded, and the frame is moved to every alternate foot and the count repeated until the opposite edge of the swath is reached. Bait counts should be taken across the swath in at least three places, each some 20 yards from the previous transect. The mean number of kernels per square foot is then calculated for all of the counts. This technique is valuable for checking the rate during the actual application where the swath transects an area reasonably smooth for bait counting.

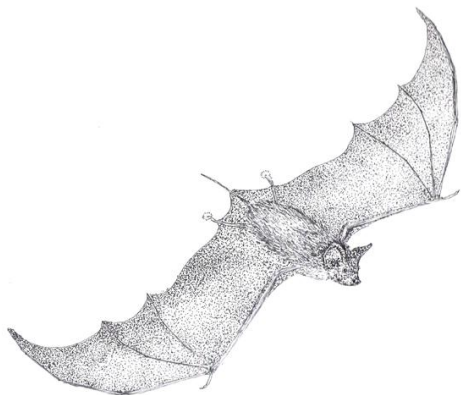
REFERENCES AND ADDITIONAL READING

A Guide For Aerial Baiting of Ground Squirrels. Rex E. Marsh, Department of Animal Physiology, University of California, Davis (1967).

BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND DIRECTIONS FOR USE

Bats

Families: Phyllostomatidae, Vespertilionidae, and Molossidae



Introduction: Bats are one of the least studied and most misunderstood of mammals. They are considered to be among the most beneficially influential mammal species to humans, plants, and other wildlife.

Bats (order Chiroptera) are the second largest order of mammals in the world, and the only mammal capable of true flight (Depaepe and Schmidt 1994). There are nearly 925 species of bat known worldwide representing 25% of all species of mammals on earth. Some bat species have been in serious decline worldwide, mostly from shrinking habitat. Despite this bats hold critical importance in consuming insect pests, pollination and seed dispersal. In addition to their contribution to biodiversity, bats can play important roles in ecosystems and provide economic benefits as consumers of agricultural and forest pest insects. serve as pollinators and seed dispersers in deserts of the southwestern U.S. (see Fleming et al.

There are 45 species of bat in the US belonging to 4 different families (NRCS 1999). Of the 24 species of identified in California, 5 form colonies or roosts in structures, particularly in older buildings with openings and gaps. Bats use structures to replace lost natural habitat. The health risk posed by bats to humans is low, but rabies is a concern that must be understood. In California all bats are insect foragers. The so called ‘vampire’ bat which feeds on blood is not found in

TABLE 3.

Five species of bats that commonly form colonies or roosts in man-made structures in California

NAME	WINGSPREAD	DESCRIPTION
big brown bat (<i>Eptesicus fuscus</i>)	13-14 in (33.0-35.6 cm)	One of the largest bats found in buildings. Most are copper-colored. Each hair is bicolored: the basal half is blackish, the outer half brown.
little brown myotis (<i>Myotis lucifugus</i>)	8.9-10.8 in (22.6-27.4 cm)	Fur is dense, fine, glossy, and rich brown in color. Ears and membranes are glossy dark brown. Of all small brown bat species, this is the one most often found in buildings.
Mexican free-tailed bat (<i>Tadarida brasiliensis</i>)	11.3-13 in (28.7-33.0 cm)	A rather small bat with long, narrow wings, best identified by tail, which extends well beyond tail membrane.
pallid bat (<i>Antrazotis pallidus</i>)	13-14 in (33.0-35.6 cm)	A large bat with big eyes, ears, and broad wings. Piglike snout is distinctive. Hairs above are light yellow and tipped with brown or gray. Underparts are pale creamy color. Membranes tan.
Yuma myotis (<i>Nyotis yumanensis</i>)	8.7 in (22.1 cm)	Light tan to dark brown; under parts whitish to buff. Membranes darker than body.

Bats
2003)
bat
many

California. Where bat removal is necessary; non lethal methods can be very effective.



Identification: Bats are the mammals that truly fly. are nocturnal and live or during the daytime in tree foliage, cavities, under loose in caves and crevices and consequently in structures, usually in older buildings,

there are many openings and gaps through which can enter.

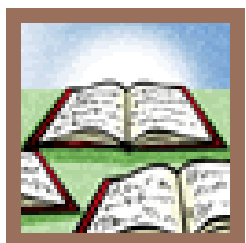


only
They
roost

bark,

where
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Bats are distinctive in appearance; looking like small rodents with webbed membrane wings. Their bodies are fur covered. They use sonar-like echolocation to navigate and hunt for food during nighttime hours.



Legal Status: Bats are subject to specific legislation. According to the [USFWS](#) of the 45 species of bat found in the US, 6 are on the endangered species list. Research and familiarity with appropriate Federal and State laws should be conducted before undertaking any nuisance management activities.

In California bats are classified as nongame mammals by the California Fish and Game Code. Nongame mammals which are found to be injuring growing crops or other property may be taken by the owner or tenant of the premises. They may also be taken by officers or employees of the California Department of Food and Agriculture or by federal or county officers or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests.

Damage: Unlike rodents, bats are not known to gnaw. Consequently, damage is limited to their physical presence and other nuisance activities. When present in and on buildings, bats can have several negative economic and aesthetic effects, as well as public health consequences (Frantz 1988).

Bats inhabiting buildings produce offensive odors and distracting noise. Bats can carry rabies. Transmission occurs when bitten by an infected bat; there is evidence that exposure of abraded skin to bat urine, or even inhalation of cave air may occur. At least eight of the 24 species in California are known to carry rabies. Being bitten by a bat is unlikely unless you are handling or otherwise disturbing bats.

Over time bat entryways to structures often have a smooth, polished appearance and this is due to oils from fur mixed with dust and other bodily fluids, as the bats pass repeatedly. This is usually an indication of heavy bat usage. There may also be staining at the entry which is slightly sticky, with bat hairs, and yellow to blackish brown in color (Greenhill & Frantz 1986).

Noise can be a problem where large bat colonies are present. Bats make noise while at roost particularly on

hot days in attics or similar spaces (Greenhill and Frantz 1986). Be aware that rustling sounds in walls and chimneys may also indicate the presence of other pests such as birds, raccoons, rats, mice or squirrels.

Guano and urine are problems encountered where bats roost inside buildings or other spaces. Sanitation can become an issue.

Brown bats are reservoir hosts for [encephalitis](#) which may also be transmitted to humans by mosquitos. Encephalitis can cause death, spasticity or mental retardation. [Histoplasmosis](#), a systemic fungus disease of man, may be contracted by inhalation of dusty bat manure containing air-borne spores of the fungus.

When removing guano it is recommended that mesh respirators be used (Tuttle 1988). Hanks 1991 states that a professional bat excluder once removed 5000lbs of guano from a 19th century building. Guano is sometimes used as a fertilizer.

Other damage caused by bats is in the variety of nuisance complaints. Often grounded in myth and with no foundation historically people have objected to bats.



Range: The California myotis bat and the big brown bat are found throughout the state except in the high mountain zones. The hoary bat, the silver-haired bat, and the red bat migrate to the coast in winter, but other species are permanent residents. The other 22 bats found in California occupy various portions of the State, with considerable overlap of distribution. Find the ranges of the common bats roosting in structures in California through the following links.

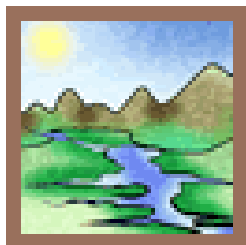
[Big Brown Bat](#)

[California Myotis](#)

[Hoary Bat](#)

[Silver-Haired Bat](#)

[Western Red Bat](#)



Habitat: All of the above bats are nocturnal, roosting in crevices, caves, tunnels, tree foliage or buildings during the day. Some species have a separate night roost to which they retire between feeding flights. Some species are more particular about the kind of roost they select than others; many hibernate in caves in winter, and may move from one cave to another several times. The most stationary species may inhabit the same roost throughout the year.

Biology: Bats are the gliders such as flying way - these species are



only mammals which are true flyers, as opposed to squirrels. Some bats migrate one thousand miles each thought to have originally colonized the Hawaiian and

Galapagos Islands.

Bats rely on reflection of high-pitched squeaks they emit to avoid collisions and to determine location of prey. Most bats live almost totally on insects captured and eaten on the wing, though two Southern California bats eat nectar, pollen and fruit as well. Bats in other parts of the world include blood eating vampires, small-fish catchers, day flyers, and large fruit eater ("flying foxes") with wingspans over five feet. Vampires and some mastiff bats can fold their wings and run about on all fours. Bats hang upside down when resting and many species conserve energy during the day by lowering body temperature (and hence metabolism) to near that of the surrounding air. Many bats hibernate in winter by a similar process.

Reproductive information on many bat species is limited. Generally, breeding occurs in autumn before hibernation, or at the winter roost, depending on the species. Mature males are recognizable at this time by the swelling of the testes in the abdomen. Ovulation occurs after winter dormancy is over, at which time the stored sperm fertilizes the egg. The young (usually only one or two, though a few species bear up to four) are born two to three months later, in May to July. The young are born naked and many cling to their mother for some time after birth; no nest is ever built. The young are able to fly at three to four weeks though some continue to nurse for several weeks longer. In many species the adults segregate when the young are born; each male lives alone through the summer while the females remain together. Most species of bats are colonial but some are solitary; both conditions may occur in some species. Bats have few enemies (owls, snakes). Bats have a lifespan up to 20 years.



Damage Prevention and Control Methods

Exclusion: The only permanent way to prevent bats from roosting in buildings is to physically exclude their entry. Bats are capable of entering openings as small as 3/8 inch. A careful inspection needs to be taken of any building suspected of containing them. It is recommended that if bats are suspected, two inspections are completed, one in daylight and one when it is dark.

When conducting the inspections look for loose flashing, vents, shingles, or siding; openings under eaves, corniches, louvers and doors, and cracks around windows, chimneys, outlet boxes or where piping/electrical wiring enters the structure. During the day, openings in dark enclosed areas such as attics may be detected more easily by light shining through the opening.

The best time for a nighttime inspection is a ½ hour before dusk, and for the following hour as this is when bats are likely to emerge.

Bat proofing (exclusion) is generally best undertaken during late fall, winter, or early spring when roost areas are naturally empty (Depaepe & Schmidt 1994). This approach avoids those periods when young and newly born bats are present. Certainly avoid mid May to mid August as this is when newly born bats are most likely to be present. It is important to note that trapped bats are likely to create unpleasant odors inside building and may even crawl away from the roost and potentially bite children or pets who attempt to pick up. Bat proofing may require use of a ladder and other devices. If you are unsure about how to proceed



a
them

contact a professional pest control operator.

Sealing: Many materials can be used to seal access points, since bats do not gnaw like rodents. The following is a list of suggested materials and are discussed further later:

- Caulking, putty, duct tape, silicone, and other cements for cracks, holes and crevices
- Self expanding polyurethane foam for cracks etc
- Weather stripping for doors and windows
- Door sweeps under doors
- Flashing where joints occur in buildings
- Hardware cloth (¼ inch mesh), window screening, plastic bird netting (¼ inch mesh).
- Insulation for blowing into wall and roof spaces
- Rags, cotton, newspaper, and tape for temporary seals.

Two favored bat proofing techniques are suggested. One is a primarily nighttime activity. The second can be conducted during daylight hours.

1. Wait until early evening and watch for bats departing from your structure. Then seal all access points, including any principal openings. The following evening ‘unplug’ several major openings to allow any remaining bats to escape. Then reseal these openings before any bats return. Repeat this routine for several nights and if any bats are seen or heard within the structure release them.

2. An alternative method which can be done entirely during daylight is to plug all principal openings and install on them a device that acts as a one way exit point for any remaining bats. This device is relatively easy to construct and consists of a rigid 2 inch plastic pipe. At one end of the pipe attach a collapsible pliable tube, use plastic tarp or similar material. Attach the other end of the plastic tube to the principal bat exit point. This will allow bats inside a roost to exit but they are unable to reenter the collapsed end of the pliable tube (Hanks 1994, E. Pierson 1994, Tuttle 1988) also suggest a variation: locate all holes the bats are using and seal, leaving 3 or 4 exits. Next hang some form of barrier material over the holes, e.g. plastic netting ¼ inch mesh, window screening, or plastic sheeting. Pierson suggests not using fruit tree bird netting as smaller bats can become entangled. Use duct tape or staples to secure the barrier material and allow it to extend 1 to 2 inches above the hole and 12 inch each side and about 1 to 22 feet below the



holes. Ensure the barrier hangs loosely since the idea is to allow the bats to crawl below the barrier to fly off. When the bats return, they try to land directly at the hole which the barrier now prevents them from entering. Once again, check nightly to ensure all bats have exited the roost before sealing the holes.

Unlike rodents, bats will not gnaw their way through wood or building materials. Effective materials to exclude bats include caulking, flashing, screening and insulation. Weather

stripping, stainless steel wool, or stainless steel rustproof scouring pads are excellent materials to block long, narrow cracks.

Caulking: Cracks and crevices develop in a structure as it ages and bats will take advantage of these openings. Caulking will seal the opening. Since wood expands and contracts with weather, it is best to apply the caulking during dry periods when the cracks will be their widest. Occasionally cracks enlarge and filler is necessary before a caulking compound is applied.

There are various caulks which may be applied with a caulking gun. Latex, butyl, and acrylic have a durability of about 5 years and can be painted. Elastomeric types such as silicone rubber and polysulphide rubber will last much longer. They expand and contract with the weather and do not dry or crack. They tolerate temperature extremes very well. Most come in color while others can be painted.

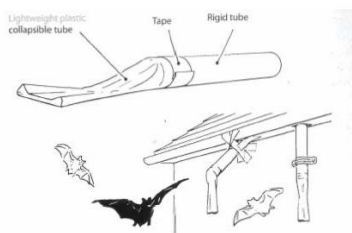


FIGURE 39.
Block all but one or two of the principal openings and install a one-way tube that allows bats to leave but prevents reentry.

Self-expanding urethane foams for caulking are available in local hardware stores in pressurized containers, and are dispensed similarly to shaving cream. When the material is placed in a hole, it will expand several times to fill the space. After it cures and hardens, it may be trimmed, sanded, and painted with any type of paint or stain.

Netting: Plastic bird netting will exclude bats from buildings. Attach netting with duct tape or staples above the bats entry or exit holes, the net should hang down about 3 feet. Attached weight to the bottom edge of the free-hanging netting to prevent wind from collapsing around the opening used by bats to exit. A 1" to 4" wide wood strip placed parallel to the bats exit hole will allow the net to hang straight down. At dusk the bats will find their way out and do not become entangled in the net. When the bats return at dawn they land on the net, but are unable to find their way around or under the net. After all bats have departed the building the entry and exit holes should be sealed.

Weather stripping: Where bats crawl under doors, the space between the floor and the door bottom may be sealed with weather stripping, a draft shield, or a gap stopper to close off the space between the bottom of the door and the door sill or threshold. Weather stripping is made of a variety of materials including natural fibers, aluminum, fine wire, felt, hard rubber, vinyl, and nylon.

Flashing: Flashing consists of strips of metal or other material to cover cracks, crevices, and holes. The materials most commonly used are galvanized metal, copper, aluminum, and stainless steel.

Screening: Where screening is necessary the openings must be small enough to prevent the access of bats, steel hardware cloth should have 1/4 inch mesh.

Bats may use an unused or old chimney because the rough surfaces of chimney walls offer suitable places for bats to hang. To prevent bats from entering chimneys, spark arresters or bird screens should be installed. These should be of rust-resistant material and carefully attached. They should completely enclose the flue discharge area and be securely fastened to the top of the chimney. Except when in use, dampers should be closed.

Insulation: The use of insulation as a bat repellent was used several years ago when fiberglass insulation was blown into roof and wall spaces occupied by bats. Insulation includes materials made of fiberglass, rock wool, cellulose, urea-based foam, urethane, vermiculite, perlite, polystyrene, and extruded polystyrene foam.

Insulation materials are manufactured in a number of forms and types. Each has advantages for specific uses. Materials and methods of application are rapidly changing and improving and no one type seems best for all applications. Effectiveness of this method is not known.

Habitat Modification

Artificial roosts have been suggested alternative dwellings for bats that have been excluded from buildings. There is little research to suggest this works. Some people who have tried this approach have had difficulty getting bats to occupy these structures (Salmon et al, 2008). Additionally, artificial roosts may lead to increased numbers of bats in an area where they are unwanted.



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Frightening

Frightening usually involves using sight and/or sound to scare animals away. It is not a recommended control method for bats. Ultrasonic devices that generate sounds are often touted as bat repellents. There is little evidence that these devices work and in some cases evidence that they may actually attract bats (Depaepe & Schmidt 1994).

Fumigants

Not a recommended control method.

Repellents

Two methods may alter roost conditions sufficiently to cause bats to leave. First, stringing electric lights for constant illumination may drive bats from roosts because they prefer dark places. Another possible repelling method is the use of electric fans to create breezes aimed at bats in roost. Neither of these methods has been tested for effectiveness.

Toxic Bait

None registered.

Trapping

Not recommended as a control method.

Other Control Methods

There are no natural controls such as diseases or predators that control bats and keep them from roosting in structures.

Reproductive control of bats has drawn research attention as an alternative to anticoagulant treatment. However, tests are not conclusive and further research is necessary (Perez-Rivero et al. 2004).

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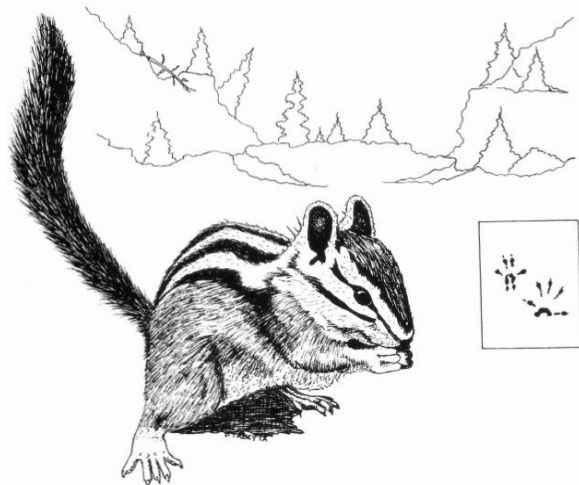
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*BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND
DIRECTIONS FOR USE*

Chipmunks

Eutamias spp.

Family: Sciuridae

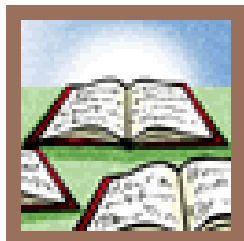


Introduction: Chipmunks are small striped squirrels and are members of the tree squirrel family. There are about 24 sub species of chipmunk found throughout North America. The only similar squirrel is the golden mantled ground-squirrel. Major differences between the two are size and striping. All chipmunks have stripes which extend to their head, the golden mantled squirrel does not have any striping on its head. Chipmunks are generally smaller than the golden mantled ground squirrel. They can be found in forested areas and scrub land.

Generally chipmunks do not cause property damage, although they are sometimes blamed for injuries to ornamental plants as they harvest fruits and nuts. Like tree squirrels, chipmunks occasionally dig up and eat spring flowering bulbs. Some homeowners get annoyed when chipmunks burrow in flower beds or under sidewalks and porches, but the burrows are almost never extensive enough to cause structural damage.



Identification: Depending on species, chipmunks can be gray to reddish-brown in color with contrasting dark and light stripes on the sides of their face and across their back and tail. They range in size from the least chipmunk, which, at 7.2 to 8.5 inches and 1.1 to 1.8 ounces, is the smallest chipmunk, to the Eastern chipmunk, which grows up to 11 inches and weighs as much as 4.4 ounces.



Legal Status: Chipmunks are classified as nongame mammals by the California

Fish and Game Code. Nongame mammals which are found to be injuring growing crops or other property may be taken at any time or in any manner by the owner or tenant of the premises. They may also be taken by officers or employees of the Department of Food and Agriculture or by federal or county officials or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests.



Damage: Around campgrounds and cabins, chipmunks often get into food and grain supplies and may be a nuisance to campers if allowed to become too numerous. Chipmunks can hamper reforestation where it relies on seed survival, but they are of little economic importance to cultivated agriculture.

Chipmunks and their ectoparasites may carry bubonic plague and Rocky Mountain spotted fever as well as other diseases. Being fairly numerous and often quite tame, chipmunks can readily transmit diseases to man if their populations are allowed to become excessively high or if allowed into close contact.



Range: There are ten species of chipmunks in California, inhabiting virtually all the mountain ranges in the state. The ten species and their approximate distributions are as follows:

E. townsendi: Sierra Nevada, northern coastal and inland ranges. *E. speciosus*: Sierra Nevada, San Gabriel Mountains and other southern California ranges. *E. umbrinus*: Sierra Nevada from Mammoth Pass south into Inyo County, and the White Mountains. *E. merriami*: Sierra Nevada south of Tuolumne County, Coastal Range south of San Francisco, many ranges of southern California. *E. amoenus*: northern Sierra Nevada, northern ranges. *E. minimus*: east side of Sierra Nevada and ranges to the east, northeastern ranges. *E. sonomae*: northern coastal ranges, other ranges in northwestern California. *E. quadrimaculatus*: Sierra Nevada from Plumas County south to Madera County. *E. alpinus*: high Sierra Nevada from Tuolumne County to Olancha Peak. *E. panamintinus*: east side of Sierra Nevada between Bishop and Olancha Pass; Panamint, White, Cocos, Inyo, Argus, and Providence Ranges. Click on the name below for more range information.

[Alpine Chipmunk](#)

[Least Chipmunk](#)

[Lodgepole Chipmunk](#)

[Long-Eared Chipmunk](#)

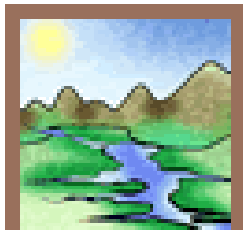
[Merriam's Chipmunk](#)

[Panamint Chipmunk](#)

[Sonoma Chipmunk](#)

[Uinta Chipmunk](#)

Yellow-Pine Chipmunk



Habitat: Chipmunks appear in a wide variety of habitats, generally preferring open coniferous forests. They are also found in chaparral, oak woodland, pinon-juniper woodland, sagebrush, and open rocky areas. Most species prefer the presence of rocks and brush in their habitat, and usually require the presence of trees.



Biology: Chipmunks are much smaller than any ground or tree squirrels. They are brightly colored, with four light-colored stripes, separated by darker stripes on their backs. Similar in appearance to the golden-mantled ground squirrel, they can be differentiated in that chipmunks have stripes on the sides of their face and possess twice as many light dorsal stripes. Their tails are fully haired, but not bushy.

Chipmunks are diurnal and have a longer activity period than California or golden-mantled ground squirrels. They are active an hour before sunrise and remain out a half-hour after sundown. They avoid the midday heat by retreating into their burrows or remaining in shade. In mid-summer, this period of inactivity may prevail from 9:00 a.m. to 4:00 p.m. At the higher elevations, chipmunks undergo a winter hibernation beginning about November. Since they do not store large quantities of fat in their bodies, chipmunks survive the winter on cached food. This food is stored in the nest and is thus readily available whenever the chipmunk awakens. They do not enter into a deep torpor as do ground squirrels, but remain relatively inactive during winter until about March. They are less often seen in winter than the golden-mantled ground squirrels. In regions where snowfall is light, they enter hibernation later and emerge earlier than the golden-mantled ground squirrels. If the snow is very light, they disappear during the storm and emerge when the snow melts. In the low desert regions, they may remain active year-round. Neither adults nor juveniles appear to estivate.

The main predators of chipmunks include: coyotes, bobcats, weasels, badgers, and hawks. Chipmunks are also occasionally preyed on by rattlesnakes, pygmy owls, golden eagles, skunks, foxes, martens, fishers, and wolverines. They are commonly parasitized by botflies (*Cuterebra* spp.), although the wounds heal readily.

Chipmunks may build nests in holes in trees (e.g., abandoned woodpecker holes) or in ground burrows, depending on the species. Nests are usually made of shredded leaves and lichen. The burrows of chipmunks are much less noticeable than those of most ground squirrels. They do not construct conspicuous mounds and there are not obvious paths leading to the mouth of the burrow. The burrow opening is usually under the edge of a stone or under a stump or tree root. The burrows are about two inches in diameter and several yards long, with branching tunnels and occasional chambers. The depth of a tunnel system varies from one to four feet.

Breeding: Males are fecund on emergence from hibernation. The females become estrous somewhat later (late March-early April). Mating occurs over a four to six-week period from about April to mid-June. Some may produce two litters annually, but most produce one per year. The gestation period is 31 days. There are from two to seven young per litter, born in May or June. The young are born naked and blind and are weaned at six weeks. They appear in the above-ground population about a month after birth. The young are sexually mature the following spring.

Food: Chipmunks feed on all manner of nuts and seeds, as well as grain, fruits, fungi, insects, bulbs, roots, leaves and flowers or a wide variety of plants, bird eggs, young birds and other meat when available. Chipmunks gather food in membranous (internal) cheek pouches and cache it underground.



Damage Prevention and Control Methods

Exclusion

Chipmunks can be excluded from buildings using hardware cloth, wire mesh $\frac{1}{4}$ inch, and caulking to close any openings. Hardware cloth is also useful to exclude chipmunks from ornamental plantings, flower beds. Seeds and bulbs can be covered with the cloth and the cloth is then covered with soil. The cloth should extend 1 foot beyond each planting.

Habitat Modification

Wherever possible reduce groundcover, trees, and shrubs as they provide protective cover for chipmunks who may wish to gain access to homes for food. Similarly, it is difficult to detect chipmunk burrows close to buildings when debris, wood piles, or ground cover provides protection. Bird feeders should be placed 15 to 30 feet away from buildings to deter chipmunks.

Frightening

Not a recommended method of control, and likely to be ineffective.

Fumigants

Chipmunk burrows are complex which makes locating burrow openings difficult. For this reason fumigant control is not effective and not recommended.

Repellents

Naphthalene flakes have been used to repel chipmunks from attics, summer cabins, and storage area, although the quantity of materials needed may cause irritation to people and pets. There is no registration

for this use and it is not a recommended approach to ridding an area of chipmunks.

Toxic Bait

CDFA Label bait Chlorophacinone 0.005% grain bait

Diphacinone 0.005% grain bait

Toxicants

Bait Grains: Crimped oat groats treated with 0.005% anticoagulant (diphacinone, chlorophacinone) is applied in bait stations.

Anticoagulant Baits

NOTE: A single feeding of anticoagulant baits will not control chipmunks. Anticoagulant baits must be eaten over a period of several days to give adequate control.

Bait stations: Place 1 to 5 pound of bait in a covered bait station in areas frequented by chipmunks (near runways, burrows, etc.). Inspect bait stations daily and add bait as needed; increase the amounts when all bait in containers is eaten overnight. Continue until all feeding ceases which may be one to four weeks. Initial acceptance may not occur until chipmunks become accustomed to the bait station, which may take several days. Replace moldy or old bait with fresh bait. Baits should be picked up and disposed of upon completion of rodent control program. Bait stations should have entrance holes large enough to admit chipmunks but not large animals, about 2 inches. Standard rat bait stations could be used but rat and mouse bait other than diphacinone or chlorophacinone should not be used. Secure bait stations so that they cannot be turned over.

Trapping

Trapping may be a practical means of control for chipmunks in limited areas. Rat snap traps can be used effectively. These can be baited with peanut butter, pumpkin or sunflower seeds, raisins, prune slices, or breakfast cereal grains. Place traps along pathways where you have seen chipmunks travel. Pre-baiting is recommended, place bait on the trap for several days with the trap unset in order to 'condition' the chipmunk. Check daily, once you notice bait being eaten, set the trap properly with bait. Always check traps frequently. Do not directly handle live chipmunks.

Live trapping (wire mesh) traps can be used to catch chipmunks. This is not a recommended procedure as live trapped animals cannot be relocated and released in California where it is illegal. Thus, you will then have to face the issue of either euthanizing the chipmunk(s) or contacting you local County Animal Services division. Euthanizing chipmunks is not recommended and requires experience and specialist knowledge.

Trapping chipmunks requires a trapping license issued by the Department of Fish and Game (see ground squirrel section for details).

Other

Shooting: Where shooting is legal, shotgun or .22 – caliber rifles are recommended. Chipmunks by nature are nervous and alert mammals, and make difficult targets.

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BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND DIRECTIONS FOR USE

Cotton Rat

Sigmodon hispidus

Family: Cricetidae

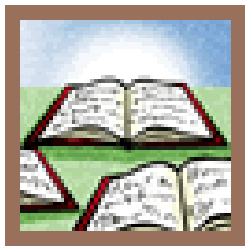


Introduction: The Cotton Rat (*Sigmodon hispidus*), is found in the southeastern United States (and Central and South America), and has a bigger body than the deer mouse. The cotton rat prefers overgrown areas with shrubs and tall grasses. The cotton rat is named for its nest building from cotton type material.



Identification: The cotton rat is a medium size rodent. The tail is scaly, sparsely haired and shorter than the head and body. Cotton rats have relatively large eyes. The ears are large and covered in fur. They have four toes and a small thumb on their front feet and five toes on each hind foot. Their fur has a rough appearance of black, gray fur. Size is about 10 inches. The cotton rat may be distinguished from the Norway rat by its smaller size, shorter tail, and longer grizzled fur. Stem and grass cuttings 2 or 3 inches long, piled at various locations along 3 to 5 inch wide

runways are evidence of cotton rats. Pale greenish or yellow droppings, about 3/8 inch in length and 3/16 inch in diameter, may also be present along the runways.



Legal Status: Cotton rats are classified as nongame mammals by the California

Fish and game Code. Nongame mammals which are found to be injuring growing crops or other property may be taken at any time or in any manner by the owner or tenant of the premises. They may also be taken by officers or employees of the department of Food and Agriculture or by federal or county officers or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests.



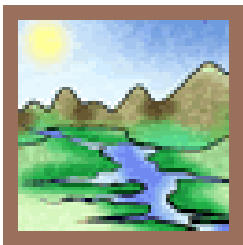
Damage: In California, damage is generally limited to sugar beets and citrus. Elsewhere, damage to cotton, grasses and alfalfa, grains, vegetable and fruit crops, squash, sugar cane, corn, sweet potatoes and melons have been reported. Cotton rat burrows may cause leakage or breaks in canal banks. Cotton rats eat eggs of quail and other ground nesting birds, and they compete with quail for food.



Range: Mexico and southern United States; in California the cotton rat is established in irrigated portions of the Imperial Valley and along the Colorado River.

[Arizona Cotton Rat](#)

[Hispid Cotton Rat](#)



Habitat: Cotton rats are dependent upon dense vegetation for both food and protection from predators. Cotton rats occupy grassy fields and meadows, marshy areas, cactus patches, wastelands, and weedy roadsides and ditch banks. Salt marshes and mixed forests are also reported habitats in southeastern states.



Biology: Cotton rats may be detected by their well-defined runways and connecting burrows. Runways are about three inches across and burrows are somewhat larger. Runways in active areas often have small piles of freshly clipped vegetation, and scattered or small piles of 1/2 inch long droppings.

Their nests are built in shallow burrows under rocks or logs or occasionally in abandoned dens of skunks and ground squirrels. Nest material includes dry grass, fibers stripped from stems of larger plants or other suitable material.

Cotton rats are good swimmers. The home range is estimated to be 1/4 to 3/4 acre for females and 1 to 1-1/4 acre for males. Cotton rats are very excitable and pugnacious and hardly an adult animal lacks battle scars.

Cotton rats are active year-round and do not store food for the winter. Although primarily nocturnal, they are often active in the day. Cotton rats are primarily vegetarians feeding on stems, leaves, roots, and seeds, but insects and animal flesh are readily eaten. Carrion is eaten and cotton rats caught in traps have been partially consumed by other rats overnight.

The reproductive rate of cotton rats is exceedingly high - they are usually the most abundant mammal wherever they occur. Unmated females come into heat every 7 to 9 days and may mate within a few hours after giving birth to a litter. The gestation period is 27 days and several litters are produced annually (average 5.6). The young are weaned at 10 to 15 days but they have been known to survive without their mother after 5 days of age. Most young breed for the first time at 2 to 3 months of age although some breed at 40 days. Several generations may be living in the same nest at one time. The average life span of a cotton rat is six months and they are considered full grown at the age of five months. Cotton rats are prey for coyotes, foxes, weasels, skunks, hawks, and owls.



Damage Prevention and Control Methods

Exclusion: If the area is small or the crop to be protected is of high value, a sheet-metal barrier 18 inches tall may be used to exclude cotton rats. Bury the barrier about 6 inches to prevent cotton rats from burrowing under it.

Habitat Modification: Habitat modification is best used as a preventive measure, since this control method will have little effect on damage once a population reaches its peak. Remove dense cover by burning, mowing, plowing, or the use of herbicides, where permissible, to reduce habitat and prevent large population increases.

Frightening: This is not a practical method for cotton rat control.

Fumigants: Fumigants are not very practical since cotton rats use their burrows and tunnels infrequently.

Repellents: None are registered for control.

Toxic Bait: None registered.

Trapping: Rat-sized snap traps are effective for catching a number of different small rodents including cotton rats. The traps should be baited with a mixture of peanut butter and oatmeal or a piece of fresh carrot or sweet potato. The trap should be set in the runway at a right angle to the direction of travel. Live traps are not recommended. Trapping cotton rats requires a trapping license issued by the Department of Fish and Game (see ground squirrel section for details).

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BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND DIRECTIONS FOR USE

Coyotes

Canis latrans



Introduction: Coyotes are very adaptable and inhabit most areas of California with the exception of major metropolitan areas. They are medium sized animals belonging to the dog family. In the hotter drier regions of California, coyotes are tan-brown in with streaks of gray. In the



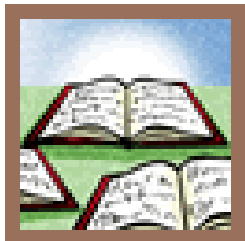
color more with

mountainous or humid areas the color is darker less brown. In the winter the coats become quite dense, especially in the colder areas. They are native to Western North America (see range map). During the last fifty years coyotes have increased their range to cover most of North America. This has been due largely to human encroachment and modification of the landscape.

Coyote interaction with humans has increased in larger suburban areas due in part to an available food supply. Further coyote information and resources are available at coyotebytes.org



Identification: The coyote resembles a medium size dog i.e. a Collie or German Shepherd type dog. They have a slender longer muzzle, erect ears, and a dark to black tipped bushy tail. Coyotes are mainly rust-brown to gray, however this can vary greatly from black, to rust, to almost white in some populations. Adult males are typically larger and heavier than females weighing 25 to 35 lbs and females from 18 to 25lbs. The voice of the coyote is quite distinctive, consisting of various howls, high-pitched yaps, and occasional dog like barks.



Legal Status: Laws regarding coyotes and coyote control are not necessarily uniform among states or even counties, and may change. Coyotes are not threatened or endangered in California and are classified as non game mammals by the Department of Fish and Game. When coyotes continue to be a problem after non-lethal methods have proven unsuccessful or when human health and safety is jeopardized, it is sometimes necessary to kill one or more animals. Coyotes can be

shot where legal and appropriate or captured using a variety of legal restraining devices. Care should be taken when trapping; steel jaw leg hold traps cannot be used to capture coyotes except where human health and safety emergencies have been declared by designated officials or where certain threatened or endangered species are themselves threatened by predation. Toxicants or poisons used to control coyotes are illegal, except for fumigant cartridges which are available to predator control specialists. California Department of Fish and Game regulations prohibit the relocation of coyotes without written permission from the Department. For further information on the legal status of coyotes and other wildlife contact your local California Department of Fish and Game Regional Office.



Damage: Coyotes can cause substantial damage. In rural areas they often kill sheep, calves, poultry. In some parts of the state they cause damage to drip irrigation systems by biting the pipes.

In other areas they cause considerable damage to watermelons, citrus fruits, avocados. Aircraft safety is often jeopardized when coyotes take up residence on or near runways. Coyotes have also been known to prey on various endangered/threatened species including the kit fox and the California least tern. In urban and suburban areas, coyotes commonly take domestic house cats, small dogs, poultry, and other domestic animals. Coyotes have been known to attack humans, and in one case, a coyote in southern California killed a three-year-old girl (Baker and Timm 1998).



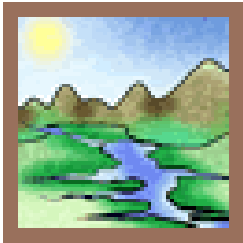
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Range: Historically, coyotes were found in the western states. Over the last 50 years they have extended their range to cover most of North America (Timm et al 2007). Coyotes live in almost any habitat in California from arid deserts to coastal regions. They are not as common in densely forested areas or planted agricultural situations due to decreased food sources. Coyotes are both transient and territorial dependent upon food resources, breeding time, and pup rearing. Where food is readily available territories are smaller. Territories can range 15 square miles to 1 to 3 square miles, and even one quarter of a square mile. Packs consist of up to 10 individuals. A dominant pair may share its area with juvenile offspring. Coyotes are not as social as wolves and can live successfully as solitary individuals.

[Coyote](#)



Habitat: Coyotes traditionally existed in large open habitats. Today, being extremely adaptable they are found in nearly all habitats. Deserts, swamps, tundra, grasslands, brush, dense forests, from below sea level to high mountain ranges. High densities of coyotes exist in suburban California.



Biology: Coyotes are most active at night and during the early morning. Coyotes 'bed in sheltered areas and use dens usually only when rearing young. They may go underground for shelter or when being pursued. They have good eyesight, hearing and sense of smell. They are extremely fast and have been measured at speeds of up to 40 miles per hour and can sustain slower for several miles (Green et al, 1994). Coyotes breed between February and March producing pups in April and May. Average litter size is 5 to 8 pups. Multiple litters may be found in one den. Coyote dens are usually selected for protective concealment and can be found in banks, rock crevices, sinkholes, underbrush and also open areas. Dens are usually located near water and coyotes will dig out and enlarge burrows made by other smaller mammals. Dens can be a few feet to 50 feet with multiple openings. In urban environments, dens can be in storm drains, under storage sheds, in holes dug in vacant lots, parks, or golf courses, or any other dry place (APHIS Factsheet 2002). Adult coyotes care for pups including non parents. Because food requirements increase dramatically during pup rearing, this is a period when conflicts between humans and urban coyotes are common. By 6 months of age, pups are nearly fully grown. About this time, mother coyotes train their offspring to search for food and family groups may be seen i.e. in parks and golf courses. If food is deliberately or inadvertently provided by people, the youngsters quickly learn not to fear humans and will develop a dependency on easy food sources. In the fall most young disperse and find their own breeding territory, but one or two pups may stay with the parents and become part of the family group.



Coyotes are carriers and transmitters (vectors) for many diseases; distemper, hepatitis, parvo virus, mange, rabies, tularemia, parasites include mites, fleas, ticks, worms and flukes. Many of these diseases are transmitted through pet or human interaction. Coyote lifespan is 10 to 12 years.



Damage Prevention and Control Methods: Coyote damage is variable depending on the situation. They may prey on pets; become a threat to public health and safety such as when they frequent airport runways or residential areas (rabies). More common is the predation by coyotes of livestock, sheep, lambs, cattle, and poultry. Over the last 100 years livestock producers and government agencies have worked at effective coyote control using toxicants, shooting, traps and other techniques.

Population models indicate the elimination of coyotes would be impossible taking decades, University of California. Increased regulations, human attitude change toward predators, and restrictions on toxicants make control difficult. In California leg traps are banned, shooting is impractical and may be banned ad hoc county to county. Modern control strategies rely on an integrated approach using non lethal and preventative techniques. Utilizing control is appropriate when other methods have been exhausted, professional or government service such as California Wildlife Services.



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fencing. They will go under, through or over the fencing. Digging is common, searching for gaps at gates or washouts. Some may jump or climb fences. Total exclusion is highly unlikely. Good fencing, however, can reduce predation and also increase the effectiveness of other control methods when they are used at the same time.

At a minimum fencing should be 5 ½ feet high (higher on slopes). Net wire mesh should be no larger than 6 inches between stays. Digging can be discouraged by running barbed wire along the bottom of fencing or burying a galvanized wire mesh apron. The scaling of fences can be discouraged by installing a wire mesh overhang of at least 18 inches, slanted at an angle facing outward, roller devices that can be attached to the top of fences are also commercially available.

Electric fencing is an option but factors such as cost and long term maintenance should be considered. Also, electric fencing may be inappropriate or even illegal in some urban areas.

Traditional exclusion management methods should always be adhered to; close off crawl spaces under porches, decks, garden sheds, and mobile homes because coyotes like to rest or rear young in these areas.

Habitat Modification: Sound or visual hazing is often used to keep coyotes away from livestock. In most cases this has only a temporary effect, and works best where the wariness of the coyotes can be maintained e.g. by interchanging control methods. In the absence of a real threat coyotes will readily adapt to; flashing lights, propane cannons, scarecrows etc. Timm 2007 reports that even strobe-siren devices only kept coyotes from sheep flocks for several months.

Maintaining the coyote's wariness is key. For example, when coyotes first encounter urban areas there is an element of wariness. Suburban residents should strive to maintain this and attempt to frighten a coyote away by shouting, throwing rocks, squirting water hose, using an air horn, or otherwise appear aggressive. Similarly, motion sensor lights on buildings may deter coyotes.

Some animal breeds are effective to exclude coyotes from pastures: certain breeds of guard dog, llamas and donkeys. Guard animals are most effective where they can see and challenge coyotes, and where they are behaviorally bonded to the livestock. Care should be taken since there are occasions when guard animals are not effective. Multiple coyotes or mountain lions may attack. In urban areas coyotes have been known to attack large dogs even in the presence of their owners, e.g. Labrador retrievers.



Suburban areas can be very attractive to coyotes; areas of lush landscaping provide food, water, and shelter. Reducing attractiveness is the key to limiting coyote encounters. Clear or thin vegetation and thereby deprive coyotes of shelter and cover. Avoid using landscaping plants that bear fruit and seeds if possible, as coyotes are attracted to ripening fruits. Fencing is useful on small garden plots (see earlier). Manage compost heaps and rodents to reduce predation. Eliminate water sources such as fountains, ponds or install net wire fences around them. Do not leave dog or cat food outside.

Frightening: Effective as a temporary method only for short periods of time. You should use before predation becomes a problem, so as to increase

wariness of the coyote. Many frightening methods have been tried, many have even been ridiculed. Essentially, anything which produces wariness is valid. Varying your position, appearance, duration, or frequency of frightening stimuli is important, even using them in multiple combinations. Lights, strobe lights, motion lights, bells, radios, parked vehicles, propane exploders, sirens.

Fumigants: Fumigation in coyotes can be effective for coyote control. A special gas cartridge is used.

Repellents: Many repellent concepts have been tested with little success. Chemical compounds which rely on smell and taste to repel have been tested with little success. High frequency sound has produced similar negative results.

Toxic Bait: None registered

Trapping: There are many effective methods of trapping coyotes. It is recommended that a wildlife professional be consulted. In California the use of steel jaw leg hold traps is illegal except under special circumstances. There are also comprehensive regulations on the use, type, identification, and checking of traps (see Law and regulations chapter).



Other

Shooting: Where shooting is legal, this is often a preferred method of predator control. However, safety must always be considered and even where legal firearm use may not be appropriate e.g. neighbors too close. Aerial hunting is strictly regulated under the Airborne Hunting Act and is allowed only with a special permit.

Denning: This is the practice of locating coyote dens and removing the pups and/ or adults. Denning is a useful control strategy where coyote predation has historically and consistently occurred. Breeding pairs of coyotes are extremely territorial and defend their territories against other canine intruders. Thus, it may be an advantage to keep a particular denning pair if they have not been preying on livestock.

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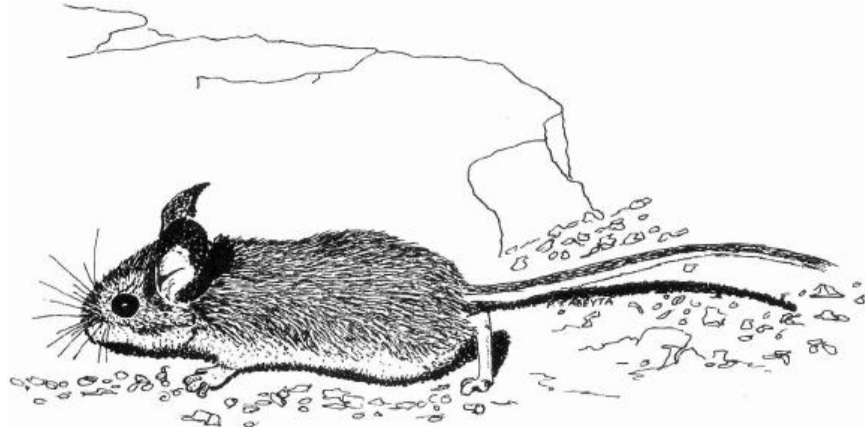
www.coyotebytes.org

BIOLOGY, LEGAL STATUS, CONTROL MATERIALS, AND DIRECTIONS FOR USE

Deer Mice

Peromyscus spp.

Family: Cricetidae



NOTE: The term "deer mice" is applied to the entire *Peromyscus* genus and to *P. maniculatus* in particular. "White-footed mice" is sometimes used in reference to the genus and it is also the common name of *P. leucopus*. In the discussion below *Peromyscus* refers to the genus unless followed by a specific name, and "deer mice" refers to *P. maniculatus*.



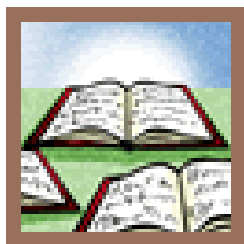
Introduction: Deer mice are one of a very large group of species and subspecies that are widely distributed throughout the United States. They are often referred to as white footed mice. Notably six species thrive in California, and of these the deer mouse is found most widely throughout the state.

Found mostly in rural areas, they are seldom a significant problem in homes and gardens, except in forested and wooded areas where they are more of a health threat than an economic threat. The biggest threat associated with deer mice is their ability to spread disease. Known to spread Rocky Mountain spotted fever they have also been linked to the Hantavirus Pulmonary Syndrome, a disease transmitted through contact with mouse carcasses or urine droplets from infected deer mice. This disease is potentially fatal, so deer mouse control is important in some areas.



Identification: Coloration varies slightly within species, but almost all have white

undersides, legs and feet, and brownish upper areas. Their tails are long, often the length of body and head and bicolored, white on the bottom and dark on the top. Deer mice have large eyes and ears. These easily distinguishable features should help to avoid confusion with the common house mouse. Additionally, there is no characteristic 'mousy odor' which is normally associated with house mice. Droppings, nests and other signs left by these mice are similar to house mice.



Legal Status: Deer mice are classified as nongame mammals by the California Fish and Game Code. Nongame mammals which are found to be injuring growing crops or other property may be taken at any time or in any manner by the owner or tenant of the premises. They may also be taken by officers or employees of the Department of Food and Agriculture or by federal or county officials or employees when acting in their official capacities pursuant to the provisions of the Food and Agricultural Code pertaining to pests.



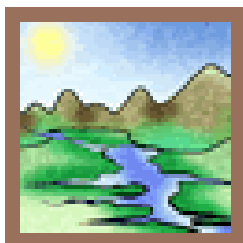
Damage: A major problem associated with deer mice is their propensity to enter homes and other structures that are not rodent proof. Once present their ability to build nests and store food can cause damage. The signs of damage are very similar to house mice. Deer mice are known to dig up and consume newly planted seeds.

Seeds of Douglas fir, ponderosa pine and other conifers are eaten. The deer mouse destroys more Douglas fir seed than any bird or other mammal. This is of primary concern in reforesting logged areas by direct seeding, although harvest of naturally dispersed seed is significant too. Deer mice have been known to dig up planted melon seeds and to eat alfalfa seed. High populations of deer mice have caused damage to almond, avocados, citrus, pomegranate, and sugar beets.



Range: *Peromyscus maniculatus* is found throughout the state. The other five species found in California occupy smaller ranges with substantial overlap. *P. maniculatus* is widespread throughout North America where more than 60 geographical races of varying degrees have been identified.

[Deer Mice](#)



Habitat: *P. maniculatus* can be found in nearly every dry-land habitat from above timberline to desert areas. The other species are more limited, preferring chaparral, oak foothills, pinon-juniper areas, rocky canyons, etc.



Biology: *Peromyscus* spp. are among the most abundant small mammals in many habitats, a fact which stems from their adaptability and mobility as well as high fertility. Hooven (1953) demonstrated that deer mice reinvaded to the center of 500-acre plots within a few weeks following satisfactory reductional control. *Peromyscus*' home range is 1/3 to four acres or more; females may display territorial behavior in the breeding season. A summer population of 15 per acre is high.

Deer mice eat a wide variety of food including seeds, nuts, acorns and insects; but they seldom consume grass, bark, or leaves as do meadow voles. Caged deer mice consumed an average of 115 Douglas fir seeds per day even when lab chow pellets were available (Cone, 1967). Deer mice collect and hoard large numbers of seeds in the fall for winter use. Deer mice are primarily nocturnal and do not hibernate.

Deer mice nest in rotting logs, stumps, buildings, burrows, the ground, trees and among rocks. The nest is lined with fine grass or other soft material. Female deer mice reach maturity at five to six weeks. The gestation period is 22 to 25 days and are one to eight young, usually three to and two to four litters are raised each. The breeding season is normally February through November. Almost bird and mammal predator feeds on mice and they are a principal prey species in North America. Deer mice live more than two years in the wild. Deer mice, in addition to nesting at or just below ground level can also be found in trees. They may utilize abandoned bird or squirrel nests, enclosing them with protective cover i.e. twigs.



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Damage Prevention and Control Methods

Deer mice are seldom a significant pest in homes and gardens, except in forest and wooded areas where the health concern is more of a threat than economic or damage issues. When their population is high, they can cause significant losses to nut crops such as almonds. Control of deer mice in structures is similar to that for [house mice](#). Habit modification and exclusion are emphasized, with trapping, and toxic baits recommended for reduction and control.

Exclusion: Permanent exclusion is the goal through rodent proof construction or subsequent modification. Examine the structure for any cracks or openings. No openings larger than 1/4 inch should be left unsealed. Deer mice will gnaw to enlarge openings to gain entry. Check foundations, water pipes, power/ cable line entry points, sewer pipes, air vents, and door seals. Deer mice are excellent climbers, openings above ground should also be sealed; chimneys and gutter pipes.

A variety of specific commercial items can be purchased to exclude e.g. Chimney screens (spark arrestors). Wire mesh 1/4 inch or smaller is otherwise sufficient. Commercial sealant and steel wool are appropriate in some situations.

Ultimately, making a structure impenetrable is a process involving constant revisiting, and may prove impossible in more remote residences, such as mountain cabins and vacation homes. When leaving residences for an extended period of time (1 month or more), store all foodstuffs including pet foods in rodent proof containers.

Exclusion using fencing is impractical since they are good climbers. Deer mice who seek seedlings in a small area should be excluded using wire mesh (see above) until the seedlings are a few inches tall. Similarly if deer mice are feeding on tree crops i.e. almonds, or other crops, place metal bands around the tree several feet from the to prevent access. This sometimes prevents the deer mice climbing the trunks although with tree canopies often touching, exclusion is nearly impossible. Broadcast and bait stations with anticoagulant baits can be used effectively.



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Habitat Modification: Habit modification is often practicable as deer mice can range up over 4 acres. Measures can be taken include creating more open space and limiting nesting opportunities which increases their susceptibility to predation. Make the area inhospitable by eliminating weeds, clearing, [mowing](#) (as Meadow Voles). When possible, clear back overgrowth of plants, particularly close to buildings, 2 feet is probably sufficient. Wood piles, fallen trees, brush piles etc should be kept at least 20 feet from buildings to prevent harborage by the deer mice. Additionally clear areas aid in identification of entry holes or damage by the deer mice.

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Frightening: This is not an effective method. Some commercial devices exist today which claim to exclude mice and other rodents from a small area. No scientific evidence is available to demonstrate their effectiveness.

Fumigants: Not a practical solution due to deer mice inconspicuousness of burrows.

Repellents: No repellents have proven effective.

Toxic Bait:

CDFR Label baits	0.01% Chlorophacinone grain bait
	0.01% Diphacinone grain bait

Toxic bait is an appropriate solution for controlling deer mice where the population is high, and adequate control in a timely manner is desired. Anticoagulants baits containing chlorophacinone and diphacinone are specifically labeled for deer mice.

The baits can be applied in bait stations or by broadcast baiting. Bait stations can be homemade or purchased in sizes designed for house mice or rats. Either size is suitable for deer mice. The aim is to keep bait dry, confined, and inaccessible to non target animals. To alert people, clearly label with an appropriate warning sign, toxicant name and owner/operator.

Toxic baits should be placed on the exterior of buildings. An exception would be outbuildings. Additionally vacation homeowners in rural areas have been known to apply toxic baits in several places indoors prior to leaving the premises for extended periods. This is an effective long-term solution. The risk is dead mice may not have desiccated prior to your return. The advantage is less chance of significant damage or contamination indoors. Alternatively, multiple snap traps can be set. Remember to fully ventilate the home and clean before inhabiting as deer mice are known vectors for Hantavirus.

Broadcast baiting is an effective solution where high deer mouse populations are sought to be controlled in a relatively short period of time i.e. 2 – 3 weeks: campgrounds, playgrounds, and other recreation areas. Often this method is preferred in agriculture and forestry environments. Ensure bait is registered, broadcasting is permissible, and adhere to rate of application.

Broadcast Baiting: Deer mice are aggressive foragers; their keen sense of smell enables them to locate food readily. Spread bait evenly by mechanical spreader, or aircraft at the rate of 2 to 6 pounds per acre through the infested area. Sufficient bait should be applied to last a minimum of 4 days (preferably without rain). In reforestation programs bait application should precede the sowing of conifer seed by 10-14 days.

Trapping: Deer mice can be trapped with ordinary mouse snap traps. Use peanut butter or peanut butter mixed with sunflower seeds or dry oatmeal breakfast cereal. Multiple traps should be used and may be required to bring population under control. Continue to keep several traps set even after control has been achieved to limit resurgence or reinvasion. Live trapping of deer mice is possible but not recommended.

An alternative trap is the glue trap, identical to those used for house mice. Use only indoors these work on the same principle as sticky fly paper – the mouse becomes stuck while traveling across the surface of the pad. Use the larger size (for rats) if purchasing commercially, and set along walls or where droppings are observed. Note that extreme dust or temperature can reduce the adherence of the board itself.

Whenever setting traps or handling deer mice or their carcasses wear gloves. Double seal the carcasses in plastic bags before disposal. As a precaution against Hantavirus, spray the carcass and trap with a solution of 3 tablespoons of laundry bleach in 1 gallon of water.

Trapping deer mice requires a trapping license issued by the Department of Fish and Game (see ground squirrel section for details).

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