GROUND SQUIRREL

Integrated Pest Management for Home Gardeners and Landscape Professionals

Ground squirrels are troublesome pests for homeowners and gardeners. The California ground squirrel, *Spermophilus beecheyi*, (Fig. 1) is the most common species in gardens. This squirrel's habitat includes nearly all regions of California except for Owens Valley, located in the southeastern part of the state, southward into the desert regions.

IDENTIFICATION

It is easy to identify ground squirrels, since they forage aboveground near their burrows. Their body measures 9 to 11 inches, while their semibushy tail adds another 5 to 9 inches in length. Their fur is brownish gray and speckled with off white along the back; the sides of the head and shoulders are light gray to whitish. One subspecies that inhabits most of Northern California has a dark, triangular-shaped patch on its back between the shoulders; this patch is missing from other species.

Although ground squirrels look similar to tree squirrels and can climb trees, when frightened they always will retreat to a burrow, whereas tree squirrels will climb a tree or tall structure and never use a burrow.

BIOLOGY AND BEHAVIOR

Ground squirrels live in a wide variety of natural habitats but usually avoid thick chaparral, dense woods, and wet areas. Populations can be particularly high in grazed rangelands and in areas disturbed by humans such as road or ditch banks, fencerows, around buildings, and in or bordering many crops.

Ground squirrels live in a burrow system where they sleep, rest, rear young, store food, and avoid danger. The burrow openings (Fig. 2) are about 4 inches in diameter but can vary considerably. The burrows can be 5 to 30 feet or more in length and can extend 2 to 4 feet below the soil surface. Often there is more than one opening in a burrow system. Ground squirrels live in colonies that can include several dozen animals in a complex of burrows. More than one squirrel can live in a burrow.

Ground squirrels are active during the day, mainly from midmorning through late afternoon, especially on warm, sunny days. Ground squirrels have two periods of dormancy during the year. During winter months most ground squirrels hibernate, but some young can be active at this time, particularly in areas where winters aren't severe. During the hottest times of the year most adults go into a period of inactivity, called estivation, that can last a few days to a week or more. During these periods, the burrow appears open at the entrance, but the squirrel plugs it with soil near the nest.

Ground squirrels breed once a year, averaging 7 to 8 per litter. Timing of breeding varies with location. In Southern California breeding begins in December, in the Central Valley the timeframe is February through April, and in the mountain ranges breeding begins somewhat later. Aboveground activity by adults is at a maximum at the height of the breeding season. The young are born in the burrow and grow rapidly. When they are about 6 weeks old, they usually emerge from the burrow. At 6 months they resemble adults.

Ground squirrels are primarily herbivorous, and their diet changes with the season. After emerging from hibernation, they feed almost exclusively on green grasses and herbaceous plants.

Figure 1. California ground squirrel.

Figure 2. California ground squirrel burrow openings.

When annual plants begin to dry and produce seed, squirrels switch to seeds, grains, and nuts and begin to store food. Ground squirrels usually forage close to their burrows. Their home range typically is within a 75-yard radius of their burrow.

DAMAGE

Ground squirrels damage many food-bearing and ornamental plants. Particularly vulnerable are grains as well as nut and fruit trees such as almond, apple, apricot, orange, peach, pistachio, prune, and walnut. Ground squirrels will enter gardens and devour vegetables in the seedling stage. They can damage young shrubs, vines, and trees

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by gnawing bark, girdling trunks (the process of completely removing a strip of bark from a tree's outer circumference), eating twigs and leaves, and burrowing around roots.

Ground squirrels will gnaw on plastic sprinkler heads and irrigation lines. They also eat the eggs of ground-nesting birds and can limit attempts to attract quail to the yard.

Burrowing can be quite destructive. Burrows and mounds make it difficult to mow, and they present hazards to machinery, pedestrians, and livestock. Burrows around trees and shrubs can damage and desiccate, or dry out, roots; it sometimes can topple trees. Burrowing beneath buildings and other structures sometimes produces damage that necessitates costly repair.

Ground squirrels can harbor diseases harmful to humans, particularly when squirrel populations are numerous. A major concern is bubonic plague transmitted to humans by fleas that the squirrels carry. Ground squirrels are susceptible to plague, which has wiped out entire colonies. If you find unusual numbers of squirrels or other rodents dead for no apparent reason, notify public health officials. Do not handle dead squirrels under these circumstances.

LEGAL STATUS

The California Fish and Game Code classifies ground squirrels as nongame mammals. An owner or tenant can control, in any legal manner, nongame mammals that are injuring growing crops or other property; tree squirrels, on the other hand, are classified as game animals and have a hunting season.

No license is required if it is the owner or tenant who is taking ground squirrels that are causing damage. A trapping license from the California Department of Fish and Game is required for those who are trapping squirrels for hire or profit.

The U. S. Fish and Wildlife Service classifies the Mohave ground squirrel, *S. mohavensis*, and the San Joaquin antelope squirrel, *Ammospermophilus nelsoni*, as threatened species; therefore both are protected animals. Although you are unlikely to misidentify either of these relatively small squirrels as the much larger California ground squirrel, their ranges could overlap in some areas.

The endangered San Joaquin kit fox (*Vulpes macrotis mutica*), several endangered species of kangaroo rats, the riparian brush rabbit (*Sylvilagus bachmani riparius*), the riparian wood rat (*Neotoma fuscipes riparia*), and some endangered amphibians and reptiles also are within the California ground squirrels' range, so some squirrel control techniques could impact them as well. Before using pesticides for ground squirrel control, read the product label to determine if any restrictions exist on rodent control within the ranges of these and other endangered and protected animals. Also, if the kit fox is found in your county, contact your county agricultural commissioner for additional information; for a range map, see the California Department of Pesticide Regulation's Web site listed in References.

MANAGEMENT

The control procedure you select depends heavily upon the unique life cycle and behavior of the ground squirrel. For example, baiting with treated grain is effective in summer and fall, because squirrels primarily feed on seeds during this period. Fumigation is most effective in spring when moist soil helps seal gasses in the burrow system. Fumigating at this time also is more effective, because squirrels die before they can reproduce. Table 1 shows the yearly activities of the California ground squirrel and times when baiting, trapping, and fumigation are most effective.

Table 1.

When to Use Specific Controls Based Upon Activity Periods and Food Sources of the California Ground Squirrel.

	Winter	Spring	Summer	Fall
Major activity periods				
Adult		■	■	■
Reproduction		■	■	
Juveniles	■	■	■	■
Major food sources				
Green forage		■	■	
Seeds			■	■
Best time for control				
Fumigation		■	■	
Baiting			■	■
Trapping	■	■	■	■

Trapping

Traps are practical for control when squirrel numbers are low to moderate. Live-catch traps aren't recommended, because they present the problem of how to dispose of the animals. Because ground squirrels carry diseases and are agricultural pests, the California Fish and Game Code specifies it is illegal to release them elsewhere without a written permit.

There are several types of traps that kill ground squirrels, including box traps, tunnel traps, and Conibear traps. For box (Fig. 3) and tunnel (Fig. 4) traps, place them on the ground near squirrel burrows or runways, and bait them with walnuts, almonds, oats, barley, or melon rinds. Place the bait well behind the trigger or tied to it.

After you bait the traps, don't set them for several days, so the squirrels become accustomed to them. After the squirrels are used to taking the bait, rebait and set the traps.

To reduce hazards to children, pets, poultry, and nontarget wildlife, place box-type traps in a covered box with a 3-inch diameter entrance. Put the box near active burrows with signs of recent diggings. Inactive burrows will be filled with leaves or old straw or have cobwebs across the entrance.

The Conibear trap No. 110 with a 4 1/2- by 4 1/2-inch jaw spread also is an effective kill trap (Fig. 5). You can bait the wire trigger, but usually you'll want to leave it unbaited. Place the trap directly in the burrow opening, so the squirrel must pass through it, tripping the trigger.

It might be necessary to use soil to partially fill in the burrow entrance around the outer edges of the trap to prevent the squirrel from slipping around the outside of the trap. Closing all other burrows with soil might hasten success by directing the squirrel to the remaining open burrow, which contains the trap. Attach the Conibear trap to a stake to prevent a scavenger from carrying off both it and the squirrel. With this type of trap, leaving the trap baited but unset has little effect on trapping success.

Inspect traps at least once a day, and remove dead squirrels. Don't handle the carcasses without protective gear; you can use a plastic bag slipped over each hand and arm as a glove. Once you have removed the squirrel from the trap, hold the animal with one hand and turn the bag inside out while slipping it off your arm and hand. If possible, keep small children and pets out of the area while traps are in use. In kit fox areas, spring all Conibear traps before nightfall and reset them the following morning.

Fumigation

Fumigation is a relatively safe method of control. As with any pesticide, read and follow label instructions with particular regard for nontarget species and safety factors. Some fumigants can produce flames, creating a fire danger. Don't use these types fumigants where a significant fire hazard exists, such as near buildings, dry grass, or other flammable materials. To prevent fumes from accumulating in enclosed areas, never fumigate beneath buildings or in burrows that might open beneath occupied buildings.

Be aware of the signs of nontarget species inhabiting inactive ground squirrel burrows. Kit foxes will use an old burrow, enlarging the opening, and often creating a keyhole-shaped entrance. Active pupping dens might contain prey remains, droppings, and matted vegetation and show signs of fresh paw prints. The burrowing owl (*Athene cunicularia*) is another potential occupant of abandoned ground squirrel burrows. Don't treat a burrow if you suspect a nontarget animal is present. Fumigate only active ground squirrel burrows; county agricultural commissioners (www.cdfa.ca.gov/exec/county/county_contacts.html) can provide additional information on how to recognize these.

Many county agricultural commissioners' offices sell United States Department of Agriculture gas cartridges, which are designed for fumigating burrowing rodents. Other types of fumigation cartridges also are available at retail outlets (Fig. 6). Fumigation is

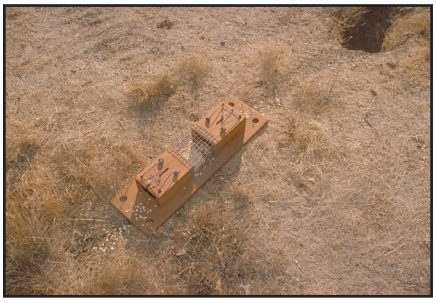

Figure 3. A pair of box-type gopher traps baited and set in a ground squirrel runway.

Figure 4. The tunnel-type trap kills animals that pass through it.

Figure 5. To use a Conibear trap, dig a slice of soil from the entrance so the trap will fit flush to the edges of the burrow entrance.

Figure 6. Inserting a fumigation cartridge into a burrow.

most effective in spring or other times when soil moisture is high, which helps contain the gas within the burrow system. Don't fumigate in summer or when the soil is dry, because the gas more readily diffuses into small cracks present in dry soil, making it less effective. Don't fumigate during hibernation, because the squirrel plugs its burrow with soil, preventing fumes from reaching the nest chamber; you can't see this plug by examining the burrow entrance.

Treat all active burrow systems when fumigating. When using a USDA gas cartridge, puncture the end with a nail or screwdriver at the points marked, and rotate the nail to loosen the material inside. Insert the fuse into the center hole. Place the cartridge in the burrow as far as possible, and light the fuse. With a shovel handle or stick, push the lighted cartridge down the burrow, and quickly seal the opening with soil, tamping it down. Fill in connected burrows if you see smoke escaping. Larger burrow systems usually require 2 or more cartridges placed in the same or connecting burrow openings. After 24 hours, check for reopened burrows, and re-treat as needed.

Toxic Baits

Anticoagulant baits, available at some county agricultural commissioners' offices and retail outlets, can control ground squirrels. The squirrel must eat the anticoagulant in several feedings during a period of 5 or more days in order for it to be effective. Because of this feature and because an antidote, vitamin K_1, exists, this bait is relatively safe for use around humans and pets. However, keep pets out of treated areas, check the areas daily, and remove and dispose of any carcasses. Dogs are more likely to eat the palletized, cereal-based baits than the loose grain baits, plus pelletized baits are prohibited in kit fox areas.

You can use anticoagulant baits in bait boxes or use repeated spot baiting or spot broadcasting, a method that involves spreading the poison near active ground squirrel burrows without leaving it in a pile. Bait boxes are small structures that the squirrel must enter in order to eat the bait. Boxes contain sufficient bait for repeated feedings. They are the preferred baiting method around homes and other areas where children, pets, and poultry are present. Follow all product label requirements for applying baits in bait boxes or by spot broadcast.

Unless a bait label specifies otherwise, you can construct bait boxes from any durable material and in a variety of designs. If you design a bait box, make the entrance hole(s) about 3 inches across to allow access to squirrels but not to larger animals. Construct a lip to prevent bait from spilling out of the box when squirrels exit. These boxes must be tamper-resistant, meaning small children must not be able to access the contents. You can do so by putting a lock on the box or devising some other method that will make it difficult for children to open. Secure the bait box, so it can't be turned over or easily removed. A self-feeding arrangement ensures the pest gets a continuous supply of bait. Never fill a bait box with more than 5 pounds of bait.

Place bait boxes near runways or burrows. If squirrels are present over a large area, space the boxes at 100- to 200-foot intervals. Initially, inspect bait stations daily, adding bait as needed. Increase the amount of bait if squirrels have eaten it all by the end of the day. Fresh bait is important, so replace moldy or old bait. It can take several days before squirrels become accustomed to the bait box and enter it.

Anticoagulant baits generally require 2 to 4 weeks or more to be effective. Continue baiting until all feeding ceases, and you no longer see any squirrels. Although few ground squirrels will die aboveground, you should pick up and dispose of those that do as described above in the Trapping section and in accordance with label directions. Also be sure to pick up and dispose of unused bait, according to label instructions, upon completion of the control program.

Habitat Modification

You'll generally find ground squirrels in open areas, although they sometimes use available cover. Remove brush piles and debris to make an area less desirable. This also aids in detecting squirrels and their burrows and improves access during control operations.

Ground squirrels can reinvade a site by moving into vacant burrows. Destroy old burrows by deep ripping them to a depth of at least 20 inches, using a tractor and ripping bar(s). Simply filling in the burrows with soil does not prevent reinvasion, as ground squirrels easily find and reopen old burrows.

Other Control Techniques

Shooting squirrels with a .22 rifle can provide some control, but it is very time consuming. Shooting is recommended only when you can do it safely and you are in a rural location where squirrel numbers are very low. There are no effective "frightening" devices or repellents that will cause ground squirrels to leave their burrows or avoid an area or crop.

When using firearms to manage squirrels, don't use lead ammunition in areas within the historical California condor range. Check with your local game warden for more information regarding these areas, and always check local ordinances before using firearms.

Natural Control

Many predators, including hawks, eagles, rattlesnakes, and coyotes, eat ground squirrels. In most cases, predators aren't able to keep ground squirrel populations below the level at which they become pests for the home gardener. Dogs might prevent squirrels from entering small areas, but they can't control established squirrel populations.

Follow Up

For those who live next to wildlands or other areas where squirrels are common, an ongoing control program will be necessary, since squirrels will

reinvade over time. Once you have controlled ground squirrels, periodically monitor the area for reinfestation. Check for new burrows, and start control actions as soon as you notice new arrivals. It is easier and less expensive to control a small population.

More information is available at the UC Ground Squirrel Best Management Practices Web site, http://groups.ucanr.org/gsbmp/, and at the UC Vertebrate Pest Control Education Web site, http://groups.ucanr.org/vpctraining/.

REFERENCES

California Department of Pesticide Regulation. 1995. *Protecting Endangered Species: Interim Measures for San Joaquin Kit Fox*. Sacramento: Pestic. Regis. Branch, Pestic. and Toxic Substances H-7506. 13 pp. Available online, www.cdpr.ca.gov/docs/es/espdfs/sjkfall.pdf and www.cdpr.ca.gov/docs/es/espdfs/sjkfden.pdf. Accessed Feb. 10, 2010.

Clark, J. P. 1994. *Vertebrate Pest Control Handbook*. 4th ed. Sacramento: Div. Plant Industry, Calif. Dept. Food and Agric. 350 pp. Also available online, www.vpcrac.org/about/handbook.php

Marsh, R. E. 1994. Belding's, California, and Rock Ground Squirrels. In S. E. Hygnstrom, R. M. Timm, and G. E. Larson, eds. *Prevention and Control of Wildlife Damage*. Vol. 1. Lincoln: Univ. Neb. Coop. Ext. pp. B.151–158.

Salmon, T. P., D. A. Whisson, and R. E. Marsh. 2006. *Wildlife Pest Control around Gardens and Homes*. 2nd ed. Oakland: Univ. Calif. Agric. Nat. Res. Publ. 21385. 122 pp.

Tomich, P. Q. 1982. Ground squirrels. In J. A. Chapman and G. A. Feldhamer, eds. *Wild Mammals of North America: Biology, Management, and Economics*. Baltimore: Johns Hopkins Univ. Press. pp. 192–208. ❖

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This and other Pest Notes are available at www.ipm.ucdavis.edu.

For more information, contact the University of California Cooperative Extension office in your county. See your telephone directory for addresses and phone numbers, or visit http://ucanr.org/ce.cfm.

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