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

Rabbits – Black-tailed Jackrabbit, Cottontail Rabbit, Brush Rabbit

Family: Leporidae

Fig. 1. Black-tailed jackrabbit (*Lepus californicus*)

Fig. 2. Desert cottontail rabbit (*Sylvilagus audobonii*)

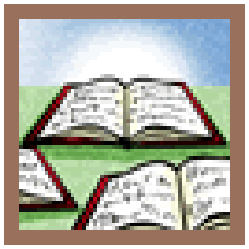
Fig. 3. Brush rabbit (*S. bachmani*)

Introduction: Three rabbits are common to California: the black-tailed jackrabbit, the cottontail, and the brush rabbit. Of these, the jackrabbit is the most destructive because of its greater size and occurrence in agricultural areas. Cottontails are common pests in landscaped areas. Hereinafter 'rabbits' shall refer to all three species unless distinguished otherwise.

Rabbits can be destructive and eat a wide variety of plants, grasses, grains, alfalfa, vegetables, fruit trees, vines, and many ornamentals. They also cause damage to plastic irrigation through their gnawing activities.

Identification: The black-tailed jackrabbit (Fig. 1) is about the size of a house cat, 17 to 22 inches long. It has long ears, short front legs, and long hind legs. They populate open or semi open lands in valleys and foothills.

Desert cottontail (Fig. 2) and brush rabbits (Fig. 3) are smaller (14.5 to 15.5, and 12.0 to 14.5 inches in length, respectively) and have shorter ears. Brush rabbits can be distinguished from cottontails by their smaller, inconspicuous tail and uniformly colored ears that lack a black tip. They inhabit brushy areas where cover is dense; landscaped areas provide excellent habitat. They can also be found beneath junipers and other large, low-growing evergreen shrubs.



Legal Status: Black-tailed jackrabbits, desert cottontails, and brush rabbits are classed as nongame animals in most states, but are considered game mammals by the California Fish and Game Code. There is an important distinction between the three species as to when control is permitted. Black-tailed jackrabbits may be taken (i.e., killed or trapped) anytime or in any legal manner by the owner or tenant of the premises, or employees thereof, if they are damaging growing crops or other property, which includes ornamental plants and irrigation lines.

Cottontails or brush rabbits may be killed or trapped by the owner or tenant of the land, or by any person authorized in writing by such owner or tenant, when the rabbits are damaging crops or forage. If any person other than the owner or tenant transports cottontails or brush rabbits from the property where they were taken, they must carry written authority from the owner or tenant. All three rabbit species cannot be sold for fur or meat. Recent legislation clarification from the California Attorney General (Opinion 06-109, 2007) makes it lawful to kill cottontail rabbits that are materially harming landscaping, ornamental plants, or gardens. The Attorney General also clarified that taking could be done by an individual or employee using air powered pellet projectiles (air rifle) within 150 yards of an occupied residence, if the rabbits are materially harming landscaping, ornamental plants, or gardens, and such use is in conformity with applicable local ordinances.

In contrast to the above information, no take is allowed for the riparian brush rabbit (*S. bachmani riparius*) which is an endangered subspecies of the brush rabbit. The riparian brush rabbit can be distinguished from other brush rabbits in that it is relatively pale in color, has gray sides, and a darker back. It also has cheeks that protrude outward when observed from above, as opposed to the other subspecies of brush rabbits whose cheeks are either flat or concave. The riparian brush rabbit is currently only found around Caswell Memorial State Park and just north of the San Joaquin River National Wildlife Refuge.

Damage: The cosmopolitan tastes of rabbits are well illustrated by the following partial list of crops and plants they damage: vegetables (beans, beet, broccoli, carrot, lettuce, peas); tree, vine, and berry crops (almond, apple, blackberry, cherry, citrus, grape, pistachio, plum, raspberry, strawberry); herbs (cilantro, parsley); hay (alfalfa); and ornamental plantings (various flowers, shrubs, trees, and turf). Rabbits also gnaw and cut plastic irrigation lines.

Black-tailed jackrabbits can be very damaging to rangelands as well. Estimates of damage vary across study localities, but 148 black-tailed jackrabbits have been estimated to consume as much forage as one cow.

Rabbits can be very destructive in nurseries, gardens, and landscaped places. This is particularly true where wild or uncultivated lands border residential zones, parks, greenbelts, or other landscaped places. Open lands, such as uncultivated wild areas, provide resting and hiding cover during the day for populations that are within easy travel distance to prime irrigated foods.

Most rabbit damage is close to the ground, except where snow allows rabbits to reach higher parts of plants. Rabbits use their incisors to make a characteristic diagonal, 45° cut when clipping

off woody twigs, buds from saplings, or flower heads. Twig clipping by rabbits is sometimes confused with deer browsing. Deer damage can be identified easily if it occurs above a height that rabbits can reach (about 2 feet) and by careful examination of the damaged twigs. Deer have no upper front teeth and must twist and pull when browsing, leaving a ragged break on the branch. Rabbits clip twigs off cleanly, as if with a knife.

Rabbits tend to gnaw the smooth, thin bark from young trees. The rough bark of older trees discourages gnawing, although old damage and gnaw marks are often present on old bark along with fresh patches of gnawing in areas of younger growth. Gnawing can completely girdle a tree, and clipping can remove the terminal shoot and lateral branches from plants. Damage by cottontails and brush rabbits is often concentrated in areas near escape cover. Black-tailed jackrabbits, however, will feed far into open areas and can eat 1/2 to 1 pound of green vegetation each day. Cottontails have been especially damaging to nursery stock and irrigation systems.

Tularemia, or rabbit fever, may be carried by rabbits. This disease is caused by the bacterium *Francisella tularensis*. Tularemia is relatively rare in humans but can be contracted by handling an infected rabbit with bare hands or by eating insufficiently cooked rabbit meat. Sylvatic plague is most often associated with ground squirrels, but has been tied to rabbits as well. Plague is caused by the bacterium *Yersinia pestis*, and is generally contracted by humans from flea bites. If a rabbit host dies, an infected flea could reattach to a human host. Rocky Mountain spotted fever is caused by the bacterium *Rickettsia rickettsii* and, although rare, can be transmitted to humans from rabbits by various tick species. Although rabbits can serve as a reservoir for brucellosis (*Brucella abortus*) and Q fever (*Coxiella burnettu*), it is unknown if these diseases can be passed directly to livestock from rabbits.

Range: The black-tailed jackrabbit is found throughout California, although it is not found in some of the higher elevation portions of the Sierra Nevada Mountains. Desert cottontails occupy most of the lower two-thirds of the state, with populations extending into the northern reaches of the Sacramento Valley and outlying foothills, as well. Brush rabbits are found along the entire expanse of California west of the Sierra Nevada Mountains, except for the dry Central Valley and southern deserts.

Black-tailed Jackrabbit Desert Cottontail Brush Rabbit

Habitat: Black-tailed jackrabbits typically occupy open grasslands and sparsely vegetated deserts in the California valleys and foothills. They are relatively sparse in the humid coast region and in the higher mountains.

Desert cottontails are abundant in grasslands, open forests, and desert shrub habitats. They also readily utilize human-altered habitats, particularly where different habitat types are juxtaposed. Brush rabbits prefer brushy areas where vegetative cover is dense. This includes early successional oak and conifer-dominated landscapes, riparian areas, or areas with abundant brambles, vines, or thickets.

Biology: The black-tailed jackrabbit is a hare rather than a rabbit. Hares are defined, in part, by the presence of fully furred young that are born with their eyes open. They can hop about shortly after birth. Also, as opposed to rabbits, hares do not burrow or utilize nests. Rather, young are born in a "form" which may be a fur-lined depression or a simpler shelter at the base of a bush or clump of grass; sometimes no form is present. Jackrabbits rely upon speed and dodging to escape enemies. They live chiefly in open places, seldom inhabiting dense brush or woods. Grazed lands tend to have larger jackrabbit populations than areas with higher grass cover.

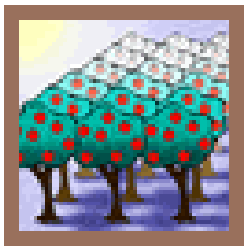
In general, the breeding season of black-tailed jackrabbits runs from early spring to late summer, although breeding may continue all year where winters are mild. Females may produce more than 1 litter a year, especially on irrigated land. After a gestation period of about 6 weeks, a litter of 1 to 8

young, usually 2 to 4, is born; the greatest number of young are produced in spring months. A year old female may produce 14 or more young each year.

The desert cottontail and brush rabbits are considered true rabbits. They build nests in shallow cavities lined in fur or dry vegetation for young, which are blind and helpless at birth. The breeding season for both rabbit species extends from December through May, although in some portions of the state, desert cottontails will breed year-round. Both rabbit species have a gestation period that lasts about 26 to 30 days. They both produce 2 to 4 litters per year, with 1 to 6 young born per litter (average is 3 to 4 per litter).

Black-tailed jackrabbits, desert cottontails, and brush rabbits are most active from early evening to early morning, and they prefer green succulent vegetation including a wide variety of forbs, grasses, and sedges during summer. As plants senesce, these hares and rabbits switch to woody shrubs, which are lower in energy and nutrients. Hares and rabbits are cecotrophic; they consume soft fecal pellets which allows them to more efficiently digest cellulose while also increasing protein intake. Hard fecal pellets are not consumed. Hares and rabbits do not require much water, deriving most of their needs from the plants they consume.

Coyotes, bobcats, hawks, and eagles are among the principal natural enemies of hares and rabbits. Jackrabbit populations build up to cyclic high levels about every 7 years followed by a drastic reduction in numbers by disease. The period of the cycle may vary from 5 to 10 years. Crop damage is more severe in years when they are abundant.



Damage Prevention and Control Methods

Exclusion: One of the most common forms of managing the problems rabbits pose is to deny them access to vulnerable areas. Fencing is currently recommended as a humane and environmentally acceptable means of excluding rabbits thereby reducing damage to agricultural, horticultural, or forestry interests.

Woven wire or poultry netting can be used to exclude all rabbits from the area to be protected. For black-tailed jackrabbits, use wire mesh of <1.5 inches, 30 to 36 inches high, with at least the bottom 6 inches buried below ground level; this buried portion should also have a 6-inch lip bent perpendicular away from the area that you are protecting to keep rabbits from digging under and around the fence. Regular poultry netting made of 20-gauge wire can provide protection for 5 to 7 years or more. The same fencing approach is used for desert cottontail and brush rabbits except that mesh size should be 1 inch or less, and height can be limited to 2 feet. Rabbits can and will jump and dig. However, the aforementioned provisions should negate this. Although the initial cost of fences is high, they can be economically feasible for protecting high-value crops and provide year-round protection on farms with a history of rabbit problems. Remember to spread the initial cost over the expected life of the fence when comparing fencing with other methods. Exclusion by fencing is desirable for small areas of high-value crops such as gardens, but is usually impractical and too expensive for larger acreages of farmland.

Electric fencing is also effective at excluding jackrabbits. Two strands placed at 3 to 4 inches and 8 to 12 inches above ground are an effective design. An electrified plastic-net fence is also an effective design. If hares jump over this design, a third strand may need to be added approximately 12 inches above the second strand.

The use of individual protectors to guard the trunks of young trees or vines is also a form of exclusion. Among the best of these are cylinders made from woven wire netting approximately 2 feet in height. Cylinders should be anchored with lath or steel rods and braced away from the trunk to prevent rabbits from gnawing on bark.

Types of trunk protectors commercially available include plastic, fabrics, poultry netting, and treated jute cardboard. Aluminum foil, or even ordinary sacking, has been wrapped and tied around trees with effective results. As tree trunks grow, protectors will either need to be enlarged or removed.

Habitat modification: The removal of hiding cover can discourage cottontails and brush rabbits, especially in suburban areas where alternate habitats may be limited. The removal of vegetation along fence rows, ditch banks, or brushy areas also eliminates preferred habitats and makes it easier to spot movement onto your property. Keep in mind vegetation management may affect other wildlife, notably songbirds. Removing cover will probably have little effect on jackrabbits because they can use cover that is often great distances from the feeding sites. Conversely, to guard against jackrabbit damage, you should encourage taller and denser vegetation. It is not recommended to supply alternate food sources for rabbits as a method to reduce damage to specific plants. One exception may be for short-term control until other direct methods of control can be used. However, the availability of alternate foods may attract more rabbits and lead to further damage. Although rabbits eat most plants when food is in short supply, some plants are preferred. A list of plants most often preferred includes:

- Asters
- Hostas
- Hybrid lilies (Asiatic and Oriental)
- *Impatiens* spp. (young flowers on young plants)
- Pansies
- Tulips
- Shrubs and Young Trees
- *Amelanchier* spp. (serviceberry, juneberry)
- *Aronia* spp. (black and red chokeberry)
- Bald cypress
- Eastern white pine
- *Euonymus* spp.(burning bush, wahoo)
- Honey locust
- *Hydrangea quercifolia* (oakleaf hydrangea)
- *Malus* spp. (apples, flowering crabapples)
- *Prunus* spp. (plum, cherry, almond, peach)

Frightening: Devices such as noisemakers and flashing lights are generally not effective. Ultrasonic units, which rely on sound waves to repel rabbits, are not effective. A dog loose within the area to be protected can be somewhat effective, depending on the dog, in keeping rabbits away.

Fumigants: Not recommended. Rabbits do not create deep enough burrows to allow for the effective use of burrow fumigants.

Repellents: Various chemical repellents are registered to prevent rabbit damage. They may be useful when applied to trees, vines, or ornamentals. Repellents can be classified as area (odor), taste, or contact (sticky) repellents. Research has shown that repellents with putrescent whole-egg solids can reduce browsing by rabbits. Repellents should be applied before damage occurs; they must be reapplied frequently, especially after a rain, heavy dew, or sprinkler irrigation, or when new growth occurs. In all cases, follow the label directions for the repellent you are using.

The usefulness of repellents is limited. They work best to protect woody plants during the early years before they bear fruit or during winter. Most cannot be used on plants or plant parts to be eaten by humans. Repellents usually fail when used in a vegetable garden, which contains highly preferred rabbit foods, even if the repellents are registered for use on edible crops.

As previously mentioned, efficacy of repellents often varies substantially depending on local conditions. Additionally, most studies on efficacy of repellents have been focused on rabbits rather than hares. That being said, fear-inducing repellents have generally been most efficacious. In particular, Deer Away Big Game Repellent®, Bobbex®, and Plantskydd® have proven effective in many situations.

Toxic bait: Toxicants are among the most effective and efficient tools for managing problematic rabbit populations. In California, the only toxicants for managing rabbits are the first-generation anticoagulants, chlorophacinone and diphacinone. These toxicants are now considered federally restricted-use materials and can only be applied by individuals who are certified applicators or are supervised by individuals who are certified applicators.

Consumption of first-generation anticoagulants prohibits coagulation of blood within the target animal, ultimately leading to death from internal hemorrhaging. Vitamin K administered by medical staff or veterinarians is an effective antidote. First-generation anticoagulants require multiple feedings over the course of 3 to 5 days for an animal to get a toxic dose. This multiple-feeding requirement reduces the threat to non-target species, but also leads to higher bait costs from multiple applications. This multiple-feeding mechanism also results in a long time from consumption to mortality, ultimately leading to substantial time intervals between the onset of a baiting program and the desired reduction in population size (sometimes 2 to 4 weeks).

First-generation anticoagulants generally pose low primary risk to most non-target species given their lower toxicity and multiple-feeding mechanism; the presence of an effective antidote also lessens risk to humans, livestock, and pets in cases of accidental ingestion. Secondary toxicity risk (when non-target species consume poisoned animals) is possible with first-generation anticoagulants. Anticoagulants can accumulate in the liver of target animals, allowing for accidental poisoning of scavengers and predators when consuming these poisoned individuals. The number of poisoned animals that must be consumed to attain a lethal dose depends on many factors including the toxicant used, the concentration of the toxicant in the liver, the species that is scavenging or predating (different species have different susceptibility levels, as do individuals within the same species), etc. In general, the risk of secondary toxicity is greatest for second-generation rat and mouse poisons, such as brodifacoum, bromadiolone, difethialone, and difenacoum; these are never allowable for use against rabbits. Risk is much lower for first-generation anticoagulants; removal of poisoned rabbit carcasses during a baiting program further reduces this risk.

First-generation anticoagulant baits generally come in grain or pelletized formulations which may be used along field edges, but not within the crop fields during the growing season; they may also be placed in a variety of non-crop areas. Anticoagulant baits are generally placed in covered or enclosed self-dispensing feeders, or covered or enclosed nursery flats. The feeders should be positioned in areas frequented by rabbits, such as trails and resting or feeding areas. If rabbits fail to feed after a few days, the feeders should be moved to where bait is readily accepted. Bait should be made available until all feeding ceases, which may be from 1 to 4 weeks. Unused bait should be disposed of according to label specifications.

Be sure to place poisoned bait where livestock and humans—especially children—cannot pick it up. Be aware of all wildlife in the area, such as mourning doves or pheasants, and take precautions to protect them from poisoning. You should protect diurnal seed-eating birds by removing or covering the bait during daylight hours, exposing it only at night.

Trapping: Cottontail and brush rabbits are relatively easy to trap alive. However, jackrabbits are very difficult to capture in this manner as they are often reluctant to enter confining spaces. Because rabbits can carry certain diseases, such as tularemia, and are considered agricultural pests, the

California Fish and Game Code makes it illegal to relocate and release without a written permit. Instead, live-trapped rabbits should be humanely euthanized via shooting or by asphyxiation through the use of carbon dioxide gas. Keep in mind that shooting is not allowable in most urban and residential areas.

A number of kill traps are effective for desert cottontails and brush rabbits. They can be trapped with a Conibear® trap (No. 110), which kills the animal outright. The Conibear® trap can be placed inside a covered box constructed out of 3/4-inch exterior plywood with a 4-inch wide entrance. To further reduce hazards to children, pets, and poultry, position the trap back from the entrance. Slots at the back end of the box help in positioning the trap, as does the hinged lid. The hole cut in the top of the hinged portion and covered with 1/4-inch mesh hardware cloth serves as a means to check the trap or bait. Other kill-type traps, such as a tunnel trap, are also available.

For best results, traps should be placed near cover where the rabbits feed or rest. For bait, use whatever the rabbits are feeding on; examples include carrots, cabbage, fresh green vegetables, or apples. The bait should be placed at the back of the trap; placing some bait just outside the trap is helpful in encouraging the rabbit to enter the trap. Be aware that one trap is rarely enough. In a garden-type setting, 3 to 6 traps are recommended. Check traps daily to replenish bait or remove the catch. Unless trapping depredating rabbits on your own property, a trapping license from the California Department of Fish and Wildlife will be required.

Multiple captures of jackrabbits are possible with funnel traps; they have been successfully used in some western states. The design is similar to that uzed in rabbit drives decades ago. For this trap, rabbit-proof fencing is erected around the edge of a crop field. A short strip of fence is then constructed at a diagonal to the main fence which funnels the jackrabbits to a one-way gate at the entrance of a holding corral. Once inside, jackrabbits cannot get out and are subsequently euthanized

Shooting: This can be an effective means of eliminating small numbers of rabbits in rural locations where it is safe to do so. As stated previously, it is now lawful to remove cottontails using air-powered pellet projectiles (air rifle) within 150 yards of an occupied residence, if the rabbits are materially harming landscaping, ornamental plants, or gardens, and such use is in conformity with applicable local ordinances (Opinion 06-109, 2007). Best results from shooting are generally achieved in early morning or around dusk when rabbits are more active. Check both local and game regulations for license requirements and any restrictions on shooting in your area.

Predators: Rabbits are prey for a number of predators, including hawks and coyotes, but in urban and suburban situations, the greatest threat is from cats and dogs. Although relatively vulnerable to predation, rabbits generally cope well and maintain their populations in spite of this threat.

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