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RABBIT CONTROL

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Common California rabbits comprise two major genera. One, the genus *Sylvilagus*, or true rabbit, is represented by the cottontail and brush rabbits. Basically, the members of this genus live in dense cover, stone piles, thickets, under buildings, or in burrows. At birth the young are covered with extremely short hair, their eyes closed, and they remain so for about 10 days. They remain in the nest until fully furred and are able to care for themselves. These rabbits are classed as game and may be taken during an open season as declared by the California Fish and Game Commission. In addition to an open hunting season on these rabbits, the California Fish and Game Code authorize their taking by land owners or tenants or persons authorized in writing by them where damage to crops or forage is being experienced. Other control methods for these species include exclusion and repellents. These methods will be discussed in more detail later in this report.

The second of the two major genera is the genus *Lepus*, or hares. These are erroneously called the jack rabbits and snow shoe rabbits. The common jack rabbit, *Lepus californicus*, is the most familiar one throughout California and portions of some of the other western states. Because of their size and abundance, they are by far the most destructive - so emphasis will be placed on this species throughout the balance of this report. Unlike the cotton tails or brush rabbits, jack rabbits occupy the open or semi-open lowlands, foothill and desert areas as well as the humid coastal region - ranging from below sea level in Death Valley to well over 12,000 ft. elevation. Females may produce from 3 to 8 per litter and as many as 3 litters a year -with an annual average of 13 to 14 young per female. The annual rate of reproduction may vary from year to year, apparently due to existing environmental conditions. In most of California the peak of the breeding season occurs during the months of April and May. This is an interesting contrast to the jack rabbits of the same species of the southern desert areas and Arizona where they apparently have two peak breeding seasons during the year --one in the winter and one in the summer which are correlated with the rainy season of that country. Young jack rabbits are fully haired, have their eyes open at birth and within a few days can shift for themselves.

The diet of the jack rabbit consists mostly of available vegetation. This includes a wide variety of herbs, shrubs, and succulent grasses. Food consumption studies have indicated that about 12 jack rabbits will consume the same amount of forage as 1 mature ewe, or that 60 rabbits will consume about the equivalent of a 1,000 lb. range cow. Because of frequent feedings on seedling plants of cultivated crops as well as grain, bark of young trees, and young grapevines, control measures are often necessary. Also, in recent years, high populations of rabbits in the vicinity of airports have brought about potential hazards to aircraft and a reduction of **the** population in these areas has been necessary.

The methods of rabbit control are several - including the encouragement of natural enemies, shooting, trapping, exclusion, repellents, and poisoning.

Natural enemies of the rabbit include the large hawks and owls, eagles, coyotes, wildcats, foxes, weasels, dogs and cats. These natural enemies are seldom ever numerous enough to control rabbits. Even though other methods must often be used, these natural enemies should not be indiscriminately slaughtered. Under certain conditions, shooting has proven effective as a means of preventing rabbit damage. Systematic patrolling in the early morning and late evening may effectively reduce the population and suppress the damage in a localized area. Organized rabbit hunts have proven satisfactory in reducing the population over local areas. This type of control is usually more effective in open terrain rather than cultivated fields, orchards, or vineyards; recently there has been reluctance by farmers and sportsmens clubs to organize these hunts due to the responsibility or liability of injury or damage involved.

Trapping with the box or similar type trap or snaring is often effective, but this is a slow method of control for cottontails. It is not a successful method for controlling jack rabbits because of their reluctance to enter a trap or dark enclosure. Trapping in conjunction with rabbit drives, where a large territory is surrounded by men and the rabbits driven into a corral, may be considered a method of trapping that has been successful. Another similar type of trapping operation is the construction of a small corral along a rabbit-tight fence surrounding a protected field. Another short strip of fence is constructed at a diagonal to the main fence, funneling the rabbits to a one-way gate into the corral. Daily inspection of the corral can then be made - and trapped animals disposed of.

Exclusion is most often accomplished by the construction of rabbit-proof fences and gates around the area to be protected. Woven wire or poultry netting of a mesh not greater than one and one-half inches, 30 to 36 inches high, with the bottom 6 inches turned outward and buried at least 6 inches in the ground, should exclude all rabbits from the area to be protected. Where it has not been practical to erect gates, dogs have been chained at the openings, provided with water and some food, and have served a useful purpose in keeping rabbits from entering. Exclusion by fencing is desirable for small areas, but most often impractical and expensive for larger acreages of farm land. The use of individual mechanical protectors to guard the trunks of young trees or vines may also be considered a form of exclusion. Among the best of these mechanical contrivances are cylinders made from woven wire netting. Poultry netting of 1 inch mesh, 20 guage galvanized wire 18 inches wide should be used. This is cut into strips 12 to 18 inches wide and formed into cylinders around the trees. To afford adequate protection, these cylinders should be braced away from the trunk to prevent rabbits from pressing them against the trees and gnawing through them.

Types of tree protectors commercially available include aluminum and nylon mesh wrapping and one made of treated jute cardboard. Aluminum foil, or even ordinary sacking, has been wrapped and tied around trees with effective results.

Various chemical repellents are offered as a means of reducing or preventing rabbit damage to trees, vines, or farm and garden crops. The purpose of a rabbit repellent is to make the protected plants less desirable by treating with a material distasteful to the rabbit. Also, a satisfactory repellent must be non-injurious to trees or plants, when applied at any time of the year.

In the past there has been a considerable variety of repellents recommended in the form of paints, smears or sprays. Many of these afford only temporary protection and must be renewed too often to warrant their use. Other materials that would last have caused injurious effects to the treated plants. Some chemical substances that have provided a certain amount of protection and yet were harmless to plants are lime-sulphur, copper carbonate, and asphalt emulsions. Concoctions using these materials had to be mixed by the applicator or farmer and have presently been replaced with various commercial preparations that are easily mixed and probably more effective. Repellents are applied either during the winter dormant season or summer growing season and recommendations vary accordingly. The following are some of the commercially available repellents: Arasan 75, Arasan 42-S, Ringwood Repellent, Improved Z.I.P., and Pennco Animal Repellent. These should be used according to the manufacturer's recommendation - which should be carefully checked as to the season for use as brush or spray recommendations may differ.

One other material often used as a repellent to protect young trees from rabbits is a strychnine poison wash. This is a mixture of strychnine sulphate, laundry starch, glycerin and water. It should not be applied, however, where domestic animals are present.

One precaution which must be taken when using repellents is that no application should be made to plants after the edible portion of the plant has started to form.

The last of the methods of control to be discussed is poisoning. The use of toxic grain baits is perhaps the most practical and economical methods of control where large numbers of rabbits are present or large areas are to be protected. Poisoning, as a means of control, should only be used if the local situation is such that humans, domestic animals, and other forms of wildlife will not be endangered.

Methods of exposing bait for rabbit control vary considerably, depending on the type of area to be treated. If baits are to be exposed on open range, stock-proof corrals may be used. These should be at least 20 ft. square with the bottom wire not closer than 10 inches to the ground. This will let the rabbits enter the corral but keep livestock or larger animals away from the exposed baits. Where rabbits are invading green fields from surrounding desert or dry areas, small handfuls of bait should be placed in trails 100 yards or more from the field for better bait acceptance. In areas where trails are not readily available baits may be distributed in small handfuls in rows about 15 ft. apart and from 5 to 10 ft. in the row. Drags in plowed land will often create a runway in which baits may be exposed. In the drier areas the addition of extra water to the bait, to the point where it can be squeezed from the bait, has also proven effective as a means of improving bait acceptance. Since the rabbits feed mostly in the evening and at night, all bait exposure should be done in the late afternoon or early evening for best results.

Prebaiting for 3 or 4 days, or if necessary, longer, is one of the essentials of a successful rabbit control program. Replenishing of prebaits in the same spots as the initial prebaiting is helpful in obtaining satisfactory bait acceptance. Toxic baits should then be placed at the locations where prebait was best accepted.

One of the most commonly used formulas for jack rabbit bait has been rolled barley with oil of anise. This is used first as a prebait and then as the toxic bait when treated with .2% strychnine alkaloid.

Other methods of bait preparation include the use of root vegetable and fruit baits; alfalfa leaves; oats; milo, barley or sorghum heads; and salt blocks or salt licks. The use of most of these methods is suitable only for protection of a limited acreage and are not too practical for the treatment of larger areas. (Formulas for the use of these baits will be included in the proceedings - so they will not be covered in detail at this time.)

Strychnine treated water has been exposed in desert areas with good results, however, this method is discouraged as there is no selectivity and it is extremely hazardous to other forms of wildlife or domestic animals that may be present in the area.

Recently the Fresno County Agricultural Commissioner's Office conducted some trials using a 1/2% strychnine bait. Bait preference plots in the trial area indicated lightly rolled oat groats to be preferred over rolled barley. Prebaiting was carried on for 4 days to establish good bait acceptance. Slightly scattered piles of toxic baits were then placed at the same locations where prebait was accepted. Bait sizes for the 1/2% strychnine baits were 3 grams, or .11 of an ounce, compared to approximately 56 grams or 2 ounces generally used in the .2% strychnine rolled barley baits. Their evaluation of these trials for this localized area indicated an estimated 90% reduction of the rabbit population and crop depredations were stopped immediately after treatment. Most of the dead rabbits were found within 100 ft. of bait placement and inspection of the stomach contents of the individual dead rabbits revealed that 3 to 5 kernels of the toxic bait had been consumed.

Anticoagulant treated baits have been used with reports of varying degrees of success - and for the most part, unsatisfactory. Some rabbits will be eliminated, but due to the large quantity of bait consumed, this procedure is not considered economically feasible - unless used to protect high priced specialty crops in areas where other types of baits cannot be used.

In moderate numbers jack rabbits are beneficial because of their value as a game animal, for their skins, and for food. When rabbits compete with livestock for feed or cause damage to trees, vines, or field crops, economic control becomes necessary. By economic control we mean the reduction of the rabbit population in a given area, to a point where crop damage is alleviated. Control directed toward specific rabbit problems is the most effective and is advocated only where considered necessary. Problems involving control measures vary for different locations and situations, and should be worked out to conform with the local conditions. The changing environment brought about by bringing new lands under irrigation and cultivation, the introduction of desirable food or forage crops into these areas, and overgrazing of rangelands encouraging growth of better rabbit forage are some factors which present problems in control procedures and techniques.

Reports on new or improved methods of preventing rabbit damage and rabbit control are actually only progress reports - as the research job of jack rabbit control is never done.

FORMULAS FOR USE IN JACK RABBIT CONTROL

POISON WASH FOR TREES:

Strychnine sulfate-----	1 ounce
Laundry (gloss) starch- -----	8 ounces
Glycerine-----	6 ounces
Water- -----	3 $\frac{1}{2}$ quarts

Prepare the laundry starch by mixing cold and then boiling in one pint of water. Dissolve the strychnine in the remaining water by boiling. Add to paste and glycerine. Cool and paint on trunks of trees. Do not admit domestic animals to orchards where this poison wash has been applied.

It may be necessary to apply repellent frequently in order to cover new growth.

Do not treat vegetables after edible portion has started to form on beans, cabbage, lettuce, etc., as the repellent may be enclosed.

POISON BARLEY WITH ANISE:

This formula has proven quite effective in many cases, possibly this may be due to the elimination of the starch from the formula or the addition of anise oil to the bait. The barley used has been termed lightly rolled or crimp rolled barley, but regular rolled barley used for horse feed will do if other is not available.

The pre-bait is prepared as follows:

100 lbs. --	Rolled barley
2 $\frac{1}{2}$ oz. ----	Table salt
3 drops	Oil anise
3 quarts	Hot water
Dye (water soluble)*	

Add salt to water and dissolve. Add anise. Pour over grain and mix.

Poison bait:

100 lbs. ---	Rolled barley
2 $\frac{1}{2}$ oz. ----	Table salt
3 drops ----	Oil anise
3 quarts --	Boiling water
5 oz. ---	Strychnine alkaloid
Dye (water soluble)*	

Slowly add a cup of hot water to the strychnine and stir until a thick paste is formed. (More hot water can be added if necessary.) Pour into 3 quarts of boiling water. Stir thoroughly while pouring in the strychnine. Add the table salt and stir until dissolved. Add oil of anise and stir. The anise may form a thin scum. Pour over grain and mix. If the above procedure is not followed, the strychnine is apt to foam and float in the boiling water,

(continued)

(continued - POISON BARLEY WITH ANISE)

The above formulas are for use in a power mixer and eliminate drying of the bait. Additional water will be necessary if the material is hand mixed.

(*) It is advisable to add some water soluble dye to both the prebait and bait to serve as a deterrent to birds and to aid in the identification of the prepared bait.

ROOT VEGETABLE AND FRUIT BAIT:

Chopped baits of any of the root vegetables, including carrots, sweet potatoes and parsnips or cull hard fruit as green pears or cull apples form a very satisfactory bait. The bait should be chopped into small squares one-fourth of an inch ($\frac{1}{4}$ inch) square, or less, washed and well drained and then sprinkled or sifted with powdered alkaloid strychnine in proportions of $\frac{1}{2}$ of an ounce strychnine with one-fourth of that quantity of common table salt ground together in a mortar, to two gallons of cut bait. The bait should be constantly stirred at the time the strychnine is sprinkled over it to insure uniform distribution. During the dry season, melons have often proven effective. Watermelons cut into portions, or left almost whole with a slice out of one side, can have the cut portion rubbed with powdered alkaloid of strychnine, or incisions made, into which crystals of strychnine sulfate are introduced.

ALFALFA LEAVES:

Dissolve one ounce of strychnine sulfate in two gallons of hot water and sprinkle over ten pounds of dry alfalfa leaves. Mix the leaves thoroughly until all the moisture is absorbed. The poisoned leaves should be distributed in small handfuls in lines a few feet apart across portions of the field where observations show the rabbits to be feeding. In locations where alfalfa is not raised, grain heads may be substituted.

POISON OATS:

Mix thoroughly one ounce powdered strychnine alkaloid and one ounce baking soda. Dissolve one heaping tablespoon of laundry starch in a little cold water, and add one quart boiling water. Boil and stir until thin, clear paste is formed. Slowly sift mixture of strychnine and soda into starch paste, stirring constantly until it becomes a smooth, creamy mass. Add one-eighth ounce of saccharin and $\frac{1}{2}$ ounce glycerine and stir thoroughly. Pour this mixture, while still hot, over twelve quarts of good oats, and mix until all grain is coated. A full tablespoonful makes a single bait spot.

POISONED GRAIN HEADS:

Barley or milo heads may be treated with the strychnine paste used in the poison oats formula, diluted with 3 pints of hot water. They should be dipped into the hot paste and then allowed to drip for a short time and dry. When gathering the heads, cut the stem 12 to 16 inches in length for convenience in dipping and exposing.

POISONED SALT FORMULA:

One ounce of table salt ground together in a mortar with 1/12 of an ounce of powdered strychnine alkaloid often gives good control, especially during the green feed period. To prevent stock from taking it, the mixture may be put into one inch holes bored into short blocks of wood. These can be placed near feeding grounds or in spots where piles of alfalfa may have been placed to attract the rabbits.

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