THE CONTROL OF RODENTS

By

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CHAPTER I

INTRODUCTION

This paper was originally an attempt to determine the effect of conical screen caps over seed spots in the control of rodent damage in the Douglas fir region. The results of the experiment were insufficient for proper thesis material due partly to my absence from school and the ecological factors on the two sites which prohibited satisfactory production.

To carry on research on the rodent problem it was necessary to know what kind of browsing rodents are detrimental to reproduction, their life history and habits, and the steps that have been taken to control them.

The two factors which are necessary for any seeding operation are first, that enough seed germinate to give rise to satisfactory stocking of an area; second that the seedling death be low enough to give development to a fully stocked stand.²

Germination of seeds depend largely on the season of sowing, the presence or absence of seed-eating mammals, and the size of the seeds.

As expressed by A. W. Moore:

"Tree seeds form an important part of the diet of many small mammals in the natural forest, but their loss is unimportant. With the removal of the trees through logging, fire, and wind, seeds again become important, and insatiable mammalian appetites become inimical as they interfere with nature's attempt to renew the forest."

The history of reforestation by broadcast seeding dates back to 1909, when nearly 4,000 acres were broadcasted and spot planted near Hebo, Oregon, on the Siuslaw National Forest. Reports show that the
experiment was a complete failure due to the presence of seed-eating animals in abundance enough to destroy not less than 80 percent of the seed sown.

Rodents not only affect the percent of germination, but after the seeds have germinated the seedlings are subject to destruction by the browsing mammals. Peavy\textsuperscript{19} stated on a plantation of knobcone pine and Coulter pine in Southern California, "Of 4,000 plants set in the early spring of 1906, all were destroyed by rabbits within a period of ten days. The greater number were eaten so completely that one had to dig below the surface in order to find the stem". Since these early experiments with seeding and planting of denuded lands, the problem of preventing the rodents from eating the seed or cropping the young plants still exists. To make direct seeding economical, an inexpensive means of protecting an area from rodents must be devised.
CHAPTER II
IMPORTANCE

The importance of any problem is the economic good or evil that it brings about. Rodents are relatively small animals, but when they group together, the damage that they can do to an area is enormous. The annual loss to agriculture and forestry caused by native mammals in the United States has been placed at $200,000,000, which is a conservative figure. The ground squirrel alone has been known to destroy up to 25 percent of the crop on the land and occasionally may destroy the entire crop. Other animals which are responsible for plant destruction are white-footed mice, pocket gophers, field mice, cottontail rabbits, jack rabbits, prairie dogs, porcupines, woodchucks, mountain beaver, and moles.

Bell has estimated the loss to the various states for the year 1917 as follows: Montana $15,000,000 to $20,000,000; North Dakota $6,000,000 to $9,000,000; Kansas $12,000,000; Colorado $2,000,000; California $20,000,000; Wyoming 15 percent of all crops; Nevada 10 to 15 percent of all crops, or $1,000,000; New Mexico $1,200,000 loss to crops and double this amount to range.23

Much of the loss from direct seeding in reforestation is due to the destruction of the seeds by rodents. In a series of experiments conducted in the Black Hills by Dearborn, it was found from 30 to 70 percent of seeds were destroyed by chipmunks and mice within six days after seeding. Exhaustive trapping on a half acre containing 2,000 seed spots obtained 3 chipmunks and 11 white-footed mice, which in three days had taken 70 percent of the seed. In one instance, a chipmunk was observed to visit 38 seed spots in 4 minutes.
Another reason why direct seeding usually fails is because it is done in the early spring when seeds are less plentiful and the rodents are in dire need of food. Smaller seeded species have a better chance of seeding an area because of a greater chance of escape from discovery. One might think that if the seed were buried in the ground it would be free from destruction. This is not the case as the rodents can detect the presence of the seeds on an area and it is only a matter of the animal getting hungry enough to dig for them.

Rodent injury may greatly reduce height growth or cause mortality on young seedlings in an area where the snowfall is heavy and the infestation of rodents is large. On good sites cropped trees may send out new shoots from adventitious buds and develop into good trees within a few years. The cropping of seedlings in artificial reforestation suffers more from animal attacks than does natural regeneration.

Cropping may not always prove detrimental as the results of an experiment conducted in 1938 on the Cascade Head Experimental Forest where 1,500 natural reproduction tree seedlings were marked to indicate species and whether cropped. After a period of 14 months mortality was found to be three times greater among the uncropped trees.

Though this thesis is primarily concerned with rodent control in regard to forest, it would not be possible to overlook rodents as they affect the grassland. The rodent problem on the "range" is as involved and just as important as the one that faces us in artificial reforestation. The rodents become competitors with domestic livestock for the forage. Estimates for grazing capacities of jack rabbits in Arizona made by Taylor and Vorhies state that, 15 antelope jack rabbits eat as much forage as one sheep, or $\frac{7}{4}$ times as much as a cow; that 30 Arizona jack rabbits would eat as much as one sheep, and $1\frac{1}{4}$ as much as one cow.
On the other hand, rodents may not be entirely pernicious. Nelson states that,

"Work of pocket gophers in soil is often of the most beneficial character, although on bare slopes their work is injurious in that it increases erosion of the fertile surface strata."\(^{31}\)

Overgrazing by sheep and cattle in the national forests has destroyed much of the perennial grasses and they have been succeeded by herbaceous plants. This vegetation is attractive to numerous rodents and wherever this food becomes available an influx of rodents follows:

"Some of the meadows of Western parks become so honeycombed by the burrow of the gophers that livestock, deer, or elk break through at every step. This hastens the process of erosion and prepares the soil for the washing which attends the heavy thunder showers so characteristic of Western mountains."\(^{30}\)
CHAPTER III

METHOD OF CONTROL

The most effective method of reducing crop loss from rodents is to reduce the number of rodents. There are several ways to go about the destruction of rodent pests. They may be hunted, trapped, gassed, and poisoned. It has also been suggested that through the employment of silvicultural measures alone, such as cutting lightly and disposing of slash and cull material as completely as possible, rodents can be adequately controlled. Rodents can also be isolated from areas by the use of wire fences, and can be kept from sown seed spots and tender seedlings by using conical screen caps. Repellents on the seed itself have also been used to prevent rodents from eating planted seed. In nature rodent populations are controlled by predators such as coyotes, foxes, wildcats, badgers, skunks, and other mammals.

Common methods of rodent control are described in the following pages:

1. POISONS

Poisoning is becoming one of the most efficient and economical means of destroying our rodent enemies. The type of poison used and the kind of bait on which it is used varies with the rodent. The poison may be very toxic to an animal, but if the bait isn't attractive the poison is useless. When poisoning the Brown Rat (Rattus norvegicus) with powdered red squill, it has been found that use of "Delicious" apples at $5.50 a bushel as the bait was more economical than use of cheaper varieties. Animals, like human beings, have their little idiosyncrasies. With this in mind it is easily understood why the
poison as well as the bait must vary with the rodent.

To give the best application of the toxic chemicals, each animal has to be considered individually. In the discussion of the important type of rodents, the best formula for their control is given. The most effective chemicals used in poisoning are described below:

**Barium Carbonate** is probably the least expensive by weight but since it needs to be so concentrated it is just as expensive as other chemicals in the long run. It is described as being both odorless and tasteless, but rats do detect it after the first time it is used. Barium Carbonate is poisonous to most rodents with the exception of mice.

**Red Squill** is the safest for the layman to use. Until the past few years there has been a great variation in toxicity of red squill. It is effective only for the first time that it is used. It is not effective on mice because they will not eat any bait that contains red squill. The chemical must be mixed dry and very thoroughly for effective results.

**Thallium Sulphate** is very efficient on almost every type of rodent. It is completely odorless and tasteless and is readily accepted by all animals. Baits poisoned with Thallium should not be handled with bare hands. Gloves should be worn while mixing the baits, and the baits should be distributed with a teaspoon. Thallium will dissolve in about 2.5 percent of water and it mixes well with hamburger. First symptoms of a sublethal dose is that the hair begins to fall out of the poisoned animals.

**Arsenic** has a distinctive taste and deteriorates very rapidly when exposed to the atmosphere. It isn't recommended as a suitable poison to employ in rodent control.

**Strychnine** is a very economical poison, does not deteriorate very
rapidly, is easy to handle, and is not injurious to gallinaceous or scratching birds. It is used generally in a powdered form but may be used in a liquid state. Strychnine is not a good poison for rats because it works so rapidly that the rats get sick before they get a lethal dose.

A.N.T.U. is the code name for the chemical alphanapthylthiourea. It is a light gray, odorless powder. Its taste varies with the individual, and it is quite insoluble in water. There is no known antidote for this poison and caution should be used when distributing exposed bait over an area because dogs are susceptible as well as rodents. A.N.T.U. is practically ineffective against mice.

The poison may be mixed with food baits; or dusted in burrows, along runways, over the surface of water, and over food piles, to make its use effective in control of rodents.

Zinc Phosphide is known under the trade name of "Rat Nip". It has a distinctive taste and odor which is probably responsible for its ineffectiveness in rodent control.

1080 is the code name for sodium fluoroacetate. It is a fluffy white powder, highly soluble in water, has a faint acetate odor, and a mild acid-salty taste. 1080 has been found to be highly toxic to most forms of life including dogs, cats, rabbits, rats, mice, field rodents, chickens, ducks, pigeons, goats, horses and monkeys.

The use of this poison is recommended only where it can be watched, in order to keep pets and persons away from the exposed area. There is no known antidote for 1080 and the hazard from secondary poisoning is greater than with any other poison now in use. 1080 can be mixed with wheat flour and dusted or 1/2 ounce can be dissolved in a gallon of water and then placed in 1/2 fluid ounce amounts around areas where damage is apparent.
The following table contains a chart of the common poisons and lists the killing time that was observed with the domesticated white Norway rat:

**TABLE I**

<table>
<thead>
<tr>
<th>Poison</th>
<th>Killing Time in Hours</th>
<th>Parts by Weight Poison to Bait</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Barium Carbonate</td>
<td>24</td>
<td>1 to 5</td>
</tr>
<tr>
<td>(b) Red Squill</td>
<td>24-100</td>
<td>1 to 9</td>
</tr>
<tr>
<td>(c) Thallium Sulphate</td>
<td>72</td>
<td>1 to 64</td>
</tr>
<tr>
<td>(d) Arsenic Trioxide</td>
<td>24</td>
<td>1 to 20</td>
</tr>
<tr>
<td>(e) Alkaloid Strychnine</td>
<td>1/2</td>
<td>1 to 160</td>
</tr>
<tr>
<td>(f) A.N.T.U.</td>
<td>12-24</td>
<td>1 to 20</td>
</tr>
<tr>
<td>(g) Zinc Phosphide</td>
<td>24-72</td>
<td>1 to 50</td>
</tr>
<tr>
<td>(h) 1080</td>
<td>4-24</td>
<td>1 to 45/4</td>
</tr>
</tbody>
</table>

Poisons can be very dangerous to people unaccustomed to handling toxic materials. The Fish and Wildlife Service has set up the following policy with respect to poisons in rodent control:

1. All possible precautions will be observed in handling and placing of baits.

2. Wherever poisons are sold the purchaser must sign a statement that he is aware of the danger and assumes the responsibility of its use.

3. State laws governing the sale of poisons must be complied with.

4. Poisons must not be put out on private lands without owner's consent.

5. Strychnine should be the most common poison in rodent control because of its fast action and humanity and harmlessness to game birds.

6. Steamed-rolled oats are recommended as bait with strychnine.
7. Thallium should not be used except on rodents resistant to other poisons.

8. Arsenic, Zinc Phosphide may be effective follow-ups.

9. Poisonous gasses should be used only by trained and experienced workers.

10. Workers should know all antidotes and how to use them.

The season and manner of applying poison bait must be adapted to the species being destroyed. If the rodent is hibernating or if there is an abundance of food for the rodent on the area where poison is distributed, the results will be ineffective. Therefore the best season for poisoning a seeding area is generally in the spring. If poisoning must be done in the fall, it should be done several weeks ahead of seeding or before the rodents begin to store their supply of food for the winter.

Originally the planting site may be nearly free from rodents, but this does not prevent migration from adjacent areas after the planting site has been seeded, due to the attraction of the rodents by the new food supply. It is therefore recommended that poisoned bait be distributed over a strip about 150 feet wide entirely around the area to be planted to act as a buffer strip.

There are many methods of distributing poison baits, and the most important consideration is to place the bait where it is not exposed to moisture. Such places may be under pieces of bark, under fallen logs, around stumps, along trails, in burrows or it can be wrapped in wax paper. In this form the bait is commonly called a torpedo.

Poisons have been severely criticised for the damage that they do to wild fowl. Recent work has been done in dying poison grain on the basis that color has deterrent reaction on birds, while rodents, being considered essentially or actually color blind, pay no attention to the color of food items. The over-all picture of color aversion as shown
by examination of 90 stomachs of birds found dead in experiments in South Dakota shows that:

"61 (68 percent) had eaten uncolored grain; 7 (8 percent) had taken yellow grain, and none had fed on the green. In 17 stomachs (18.9 percent) digestion had removed evidence of oats having been eaten, and in 5 (6 percent) the identification of color was questionable."

2. GASSING

The use of gas in controlling rodents has not been common until the past few years. With the introduction of calcium cyanide, the efficiency of gassing has greatly increased. Gas is useful in areas where animals refuse to take bait. In treating an area, gas is somewhat more expensive than poison, owing to the fact that there are several holes to each rodent and it is necessary to treat more holes than there are rodents present. One of the best ways to use calcium cyanide is in the granular form. It can be deposited in the burrows with a large spoon.

Cyanide is toxic enough to kill anything, but at the present time there is no efficient method for killing pocket gophers or moles. The trouble lies in the manner of placing the material and not with the material itself. The use of cyanide at the present time is only recommended against rats and ground squirrels.

3. CONICAL SCREENS

Covering seed spots with wire screens is one of the most effective ways of protecting seed from depredation by small rodents. Experiments that were made on the Kaniksu National Forest and Coeur d' Alene National Forest in the fall of 1937 and summarized in Table II, show that an average of 93 percent of the screen spots had one or more seedlings at the end of the first growing season.

Cones or domes are made out of 1/3 or 1/4 inch mesh, 21-gage
galvanized iron wire. The cones can be made by cutting a disk out of hardware cloth with a diameter of about 10 inches. The disk is then cut in half and the ends of the halves are pulled together and stapled with a "hand" stapling machine. The method of making domes as described by the Fish and Wildlife Service is as follows:

"Standard 40-inch widths of hardware cloth can be cut with cutting dies and a hydraulic press into disks 9.6 inches in diameter with only a small loss of material. The bowl of the die is 3.75 inches deep and 6.5 inches in diameter at the rim, inside measure and may be made of wood or steel. If made of wood, it should have a band of strap-iron about it to prevent it from splitting. The punch of the die is made of steel and is of a size and shape to fit into the bowl. It should be provided with a suitable handle."37

(Courtesy U. S. Fish and Wildlife Service)

FIGURE 1

A roughly made bowl and punch die for making wire domes.
When placing the domes or cones over the seed spots they should be worked into the ground until the rim is at least one inch below the surface of the ground. Then dirt should be firmly packed around the edges leaving about 3 inches of the dome or cone showing. The domes or cones should be left over the seed spots during the first year. The screen will not affect the growth of the seedling.

(Courtesy U. S. Fish and Wildlife Service)

FIGURE 2

A dome that has been in place during two growing seasons.
### TABLE II

Germination, mortality, and degree of stocking in direct-seeding plots*

<table>
<thead>
<tr>
<th>Location of plots</th>
<th>Species</th>
<th>Germination</th>
<th>Mortality**</th>
<th>Stocked spots***</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Screened</td>
<td>Unscreened</td>
<td>Screened</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Fall</td>
<td>Spring</td>
<td>Fall</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sown</td>
<td>sown</td>
<td>sown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Average number of seeds germinated per spot</td>
<td>Percent of germination</td>
<td>Percent of total spots</td>
</tr>
<tr>
<td>Kaniksu National Forest</td>
<td>Ponderosa pine white pine</td>
<td>24.4 5.6 0.5 0.2</td>
<td>5.4 19.0</td>
<td>100 65 25 10</td>
</tr>
<tr>
<td></td>
<td>Western white pine</td>
<td>9.8 1.5 0.4 0.1</td>
<td>19.4 35.2</td>
<td>85 32 18 1</td>
</tr>
<tr>
<td>Coeur d'Alene National Forest</td>
<td>Western white pine Engelmann spruce</td>
<td>28.8 14.4 1.0 0.4</td>
<td>11.1 10.2</td>
<td>91 20 39 20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25.8 25.3 7.6 8.4</td>
<td>21.9 25.7</td>
<td>96 67 84 67</td>
</tr>
<tr>
<td>Average for all species</td>
<td></td>
<td>22.2 9.2 2.4 2.3</td>
<td>15.2 22.5</td>
<td>93 46 42 24</td>
</tr>
</tbody>
</table>

* Each figure on fall-sown seed is based on 288 spots; each figure on spring-sown seed is based on 192 spots.

** Mortality for unscreened spots was omitted because of insufficient numbers of seedlings on which to base percentages.

*** Number of spots having one or more seedlings at end of first growing season expressed as a percentage of the total number of spots sown.

From Direct Seeding in the Western White Pine (21).
The cost of screening is an important consideration in this method of control. The wire cones or domes cost about $.04 each but may be used over a period of ten years. Thus the cost of protecting each seed spot will be about $.004. The requirements for a fully stocked stand in the Douglas fir region is that there must be 600 or more well distributed seedlings per acre. Allowing for survival of at least one seedling in 93 percent of seed spots, $\frac{643}{3}$ screen caps are required to secure adequate stocking on each acre. This brings the cost up to $2.68 per acre exclusive of labor cost in planting seed, pressing screens into place, and picking them up at the end of the year. This control is not effective in localities where large rodents can take the seeds by moving the screen from the seed spots. 37

4. TRAPPING

Trapping is slow and an expensive process which makes it very impractical for large scale rodent control, although trapping is one of the few effective means of combating moles and gophers. There are many good gopher traps now on the market and most of them work on the principle of having the trigger set back between the jaws so that as the animal pushes earth ahead of him to plug the opening, his body is clamped between the jaws of the trap when the trigger is tripped by the load of earth. 1

5. REPULLENTS

Certain chemicals which emit odors that are repugnant to rodents have been tried on seeds in reforestation. These include many substances such as tung oil, coal tar, creosote, pine tar, copper sulphate, flake naphthalene, powdered sulphur and lime, nicotine sulphate compound, pyrethrum, copper carbonate, the oils of citronella, cedarwood, wintergreen, and peppermint. None of the repellents has proven outstanding,
probably due to two reasons: The first is that the chemical deteriorates readily when exposed to the atmosphere, and second, that the chemical must be of a nature not detrimental to the germination of the seed.
In the introduction it was stated that it was important to know the most common of the rodent pests in order to develop a better understanding of the rodent problem. It was not possible to include all the 14 different genera or the 750 different varieties that inhabit the United States and Canada, so this thesis contains only the rodents that are the most harmful to forest growth. The rabbits, which are not true rodents, have also been included, because of their destructive habits to young forest vegetation. They belong to the closely related order (Logomorpha) which differ from the order (Rodentia) in that the latter have four incisors instead of two in the upper jaw.

PORCUPINE - Erethizon epixanthum

Common Names - Porcupine; Quill-pig.

General Description - The porcupine is a large, clumsy rodent with long, sharp spines on its back and tail that come out very easily when disturbed.

Distribution - The porcupine is found in the forested area of eastern Oregon and the southern part of the western slopes of the Cascades. It has also been found in the Willamette Valley.

Enemies - It is well equipped to protect itself from most enemies except man.

Food - Mostly bark, buds and foliage of many trees principally cottonwoods, willows, aspens, hemlock and ponderosa pine.

Life History and Habits - During the summer the porcupine feeds upon ground vegetation and the fall and winter diet consists of the bark and leaves of
coniferous trees. In their efforts to get at the inner layer of bark they often completely girdle the boles of western yellow pine.

The one or two young are born in the spring, each weighing about 1\(\frac{1}{2}\) pounds. The porcupine in the Northwest lives in the shelter of lava dens in the cold season and during the warmer months migrates to valley farms in search of succulent food.

Control - Porcupines are very fond of salt, and poison stations can be set up along lines of migration. Poisoned salt can be placed in wooden blocks which are nailed 8 to 10 feet above the surface of the ground in ponderosa pine trees. The formula for this mixture is one pound of common table salt, 1 ounce of powdered strychnine, and one-half ounce of magnesium carbonate.

MOUNTAIN BEAVER - Aplodontia rufa

Common Names - Mountain Beaver; Showtl; Sewellel Mountain Boomer; Wood-chuck; Groundhog.

General Description - The mountain beaver is a short-legged, heavy-bodied rodent from 12 to 13 inches long; tail so short as to appear absent; eyes and ears small with fur of a coarse brownish color.

Distribution - Found only in a narrow strip along western part of Pacific States.

Enemies - Great horned owls, golden eagles, gray foxes, mink, wildcats, weasels, and skunks.

Food - Mostly green vegetation, foliage and branches of many species of ferns, plants, shrubs, and young trees.

Life History and Habits - The mountain beaver lives in extensive underground burrows with several entrances, usually on hillsides. The young are born in April and a litter varies in number from 3 to 5.
The animals cut the tops of various plants and pile bundles outside their burrows to wilt before being carried inside. They are nocturnal and are rarely seen above ground in the daytime. One can live in a region frequented by the mountain beaver and never detect the presence of the animal.

Control - Poisoning seems to be the only available control measure. An apple cut into four slices and dusted with powdered strychnine in the proportion of 1 ounce of strychnine to 16 quarts of bait. Clean pieces of apple should be placed in the entrance to their burrows two or three days before the bait containing poison is used.

WHITE-FOOTED MICE - Peromyscus maniculatus

Common Names - White-footed Mouse; Deer Mouse; Vesper Mouse; Wood Mouse.

General Description - The white-footed mouse is of medium size; tail long, about half of total length; eyes rather large; and is recognized readily by the clear white underparts, as contrasted with upper dark brown color.

Distribution - Found throughout North America from sea level to the limits of plant growth on the crests of the mountain ranges, and from regions of heavy annual precipitation to the most arid deserts. These small mice have the reputation for being the most common of small rodents in North America.

Enemies - Preyed upon by many species of owls, some hawks, weasels, foxes, and practically all of the small carnivorous mammals.

Food - Mostly seed and grains, small nuts and dry vegetable food. The forest provides food from April to September and when the seeds are no longer available the mice depend on insects and insect eggs and larvae, young conifer seedlings, and yellow weed or false dandelion for existence.

Life History and Habits - White-footed mice are strictly nocturnal. They
may be found in the cover of fallen logs, in piles of rocks, and other
shelter of forest and brush land. In open country the mice live in
burrows in the earth or sand. Where there is cover the species builds
nests in slash or in many cases use old nests made by birds.

These mice have usually four litters a year, with a litter varying from 3 to 7. The young can be seen at almost any time and the first litter has been seen as early as April. White-footed mice have interesting habits and make good pets; they are gentle and easy to tame.

Control - For extensive control operations against white-footed mice the steamed-rolled oats and the strychnine alkaloid bait have been used with good results. The bait contains the following ingredients:

- Steamed-rolled oats 12 pounds
- Powdered strychnine alkaloid 1 ounce
- Baking soda 1 ounce
- Gloss starch 3/4 ounce
- Water 1 pint
- Heavy corn syrup 1/4 pint
- Glycerine or petrolatum 1 tablespoonful

"Mix the starch with 1/4 teacupful of cold water, stir into 3/4 pint of boiling water, and cook until it forms a thin clear paste. Mix the strychnine with the baking soda, add to the starch paste, and stir until it is free of lumps. Add the heavy corn syrup and the glycerine or petrolatum. Pour mixture over the oats and stir thoroughly until each kernel is uniformly coated." 37

This steamed-rolled oats and strychnine bait is best for the initial baiting. The bait should be placed at intervals of 20 feet when the vegetation is not heavy. This first poisoning should be followed in 10 to 20 days by a second treatment of steam-rolled oat groats and thallium sulphate bait. The contents differ somewhat from steamed-rolled oats and strychnine formula.
Steamed-rolled oat groats 125 pounds  
Thallium sulphate 1 3/4 pounds  
Water 1 gallon  
Dry gloss starch 1/2 pound  
Glycerine or petrolatum 3/8 pint  

"Dissolve the thallium sulphate in 3 3/4 quarts of boiling water. Mix the starch with 1 pint of cold water. Stir this into the thallium solution and cook until a clear paste is obtained. Add the glycerine (or petrolatum) but this may be omitted if the poisoned grain is to be used immediately. Pour the mixture over the oat groats and mix thoroughly."  

This bait should be placed under pieces of bark, chips or other cover under which mice run. There should be at least one bait to every 400 square feet.

**BLACK-TAILED JACK RABBIT** - Lepus californicus  
**Common Name** - Jack Rabbit.  
**General Description** - The jack rabbit is a large, long-legged, long-eared animal, easily distinguished from the white-tailed jack rabbit and from the cottontail by the color of the tail, and by its much larger size.  
**Distribution** - The black-tailed jack rabbit is found all over the State of Oregon, except along the coastal region.  
**Enemies** - Coyotes, wolves, and eagles.  
**Food** - Twigs, bark, foliage of many species of shrubs, grasses, plants, and trees.  
**Life History and Habits** - Jack rabbits have from 2 to 4 young in a litter and may have several litters a year. Both the sense of sight and of hearing is keen in the rabbits, and often the Jack runs away before the hunter approaches. The speed of the Black-tail is much faster than that of the average dog. Rabbits do a great deal of damage to planted stock while the natural conifer reproduction may be cropped only lightly or moderately.
Control - Success in poisoning rabbits depends largely on the season of the year, and the one method of control that can be used effectively throughout most seasons is the rabbit salt formula.

Strychnine (powdered alkaloid) 1 ounce
Salt 2 ounces
Alfalfa meal 2 ounces

The above ingredients are mixed together and placed in wooden containers near rabbit trails.

WESTERN CHIPMUNK - Eutamias townsendii

Common Names - Western chipmunk; chipmunk.

Description - The Western chipmunk is a small rodent about 10 inches long. Upper parts varying with season from yellowish olive gray to rich yellowish brown; well developed cheek pouches, narrow erect ears, head somewhat rounded, active and alert in behavior.

Distribution - Found in humid coastal regions of Oregon and Washington.

Enemies - Snakes, weasels, hawks, foxes, coyotes, badgers and wildcats.

Food - Seed, nuts, buds and berries.

Life History and Habits - Chipmunks have but one litter of young a year which number from 4 to 6. They make their nest underground, burrowing into the earth at the foot of a stump or beside a rock or log, and are terrestrial in habit. Chipmunks very often climb short distances up a tree trunk when running from an enemy. When feeding they often climb trees or shrubs for seed and nuts. They are active most of the year and may be seen on bright sunny days in the winter.

Control - One treatment that has met with good success on recent burned areas is spreading hulled sunflower seed treated with thallium sulphate on direct-seeding areas about a week before the seed is sown. In addition, the seed to be sown is treated with a mixture of plaster of
Paris, yellow dextrine, cornmeal, and strychnine alkaloid.

POCKET GOPHERS - Thomomys

Common Names - Pocket gopher; ground rat.

Description - The different species of this genus vary in color from light brownish yellow to black. The size ranges from 7 inches in length to 12 inches or more. On each side of the head is a large fur-lined pouch that opens externally instead into the mouth as in cases of the squirrel.

Distribution - Found throughout Western North America.

Enemies - Snakes, weasels, coyotes, owls, hawks, foxes, badgers, and bobcats.

Food - Underground growth, such as bulbs, roots, tubers, as well as surface vegetation of green foliage, grain and bark.

Life History and Habits - The exact number of litters the pocket gopher has each year is not known, but the young in each litter vary from 4 to 8. When the young are about half-grown they leave the burrow and start one of their own. One animal may travel one or two hundred yards to a mile from its birthplace. Gophers are active during the summer and winter digging long burrows to new feeding grounds. Most of digging is done with the foreclaws, with some help from the incisors. The gopher cuts a clean burrow and brings debris to the surface or to some part of the unused underground passages. These loose mounds of earth may be seen at intervals of 10 to 20 feet, which mark the course of the runway system. The entrance to the burrow is kept plugged except when the gopher is working.

Control - Clover tips treated with strychnine (alkaloid) have given very satisfactory results. 10 pounds of green clover tips are sprinkled with 1 ounce of strychnine and stirred until thoroughly mixed. The tips are
inserted in the fresh runways and then precaution should be taken to keep dirt or light from falling on the bait.

**GROUND SQUIRRELS - Citellus and Related Forms**

**Common Names** - Douglas ground squirrel; Oregon ground squirrel; Columbian ground squirrel.

**General Description** - The Columbian ground squirrel is the best example of the genus *citetellus* to describe. It is a terrestrial, burrowing squirrel of a large size and short tail. Body is rather large and is a general reddish brown color with particularly red underparts.

**Distribution** - Douglas ground squirrel is found in Western Oregon from the Columbia River to the California line. The Oregon ground squirrel is distributed in the sagebrush plains of Northeastern California and Southeast Oregon. Columbian ground squirrel is found in the mountains from Western Montana, Eastern Oregon and Washington, north to Canada.

**Enemies** - Weasels, badgers, coyotes, wolves, foxes, bobcats, and hawks.

**Food** - Mostly seed, nuts, grains, green vegetation, roots and insects.

**Life History and Habits** - Ground squirrels very seldom climb trees. They are strictly terrestrial in habit. These squirrels seldom get very far from their burrow and run for it when danger approaches. They like the openings in the forest where grasses, flowering plants and shrubs grow, or south and east slopes where scattered oak and brush appear. Ground squirrels live in colonies and number from 12 to a hundred or more. The young are chiefly born during the month of April and average about 8 to a litter.

**Control** - The Fish and Wildlife Service recommends the following formula as the most effective throughout the season:
<table>
<thead>
<tr>
<th>Item</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barley (clean grain)</td>
<td>16 quarts</td>
</tr>
<tr>
<td>Strychnine (powdered alkaloid)</td>
<td>1 ounce</td>
</tr>
<tr>
<td>Bicarbonate of soda (baking soda)</td>
<td>1 ounce</td>
</tr>
<tr>
<td>Heavy corn syrup</td>
<td>1/4 pint</td>
</tr>
<tr>
<td>Thin starch paste</td>
<td>3/4 pint</td>
</tr>
<tr>
<td>Glycerine</td>
<td>1 Tablespoonful</td>
</tr>
</tbody>
</table>

Mix thoroughly in a clean vessel 1 ounce of powdered strychnine and 1 ounce of common baking soda. Over this pour 3/4 pint of thin, hot starch paste and stir well. (The starch paste is made by dissolving 1 heaping tablespoonful of dry gloss starch in a little cold water, which is then added to 3/4 pint of boiling water. Boil and stir constantly until a clear thin paste is formed.) Stir in 1/4 pint of heavy corn syrup and 1 tablespoonful of glycerine, making sure that none of the heavy syrup paste sticks to the bottom of the container. Pour this mixture over 16 quarts of good clean barley and mix well so that each grain is coated.
SUMMARY

The area in need of reforestation in the Douglas fir region in 1933 was estimated at 3,426,000 acres. This land that is in a non-stocked or deforested condition is in need of an economical means of artificial reforestation.

One of the cheapest methods of restocking an area would be through broadcast seeding if the loss of seed from rodent damage could be kept to a minimum. No definite solution has been given for an adequate method of control (at a cost that would be feasible) to employ in conjunction with large-scale broadcast seeding. However, with the introduction of new poison chemicals in the past few years, the near future may find an answer to the rodent problem on the non-stocked areas of denuded forests in the Northwest.
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