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FOREST ANIMAL DAMAGE CONTROL

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As a nation we have gained world recognition for our ability to utilize our resources. In forestry our greatest accomplishments have been in the mechanization of harvest methods and in improvements in forest products. The renewal of this resource has been our greatest neglect. Though the end of the 19th Century marked the beginning of the conservation movement, it was not until a half century later that the force of economics through the demands of a growing population made forest re-establishment more than just a desire.

Conservation in itself is a Utopian concept which requires other motivating forces to make it a reality. In the post-war years, and as late as the early 1950's, stocked land in the Pacific Northwest could be purchased for less than the cost of planting; the economic incentive was lacking. Only with sustained yield management and increased land values was there a balance in favor of true values. With greater effort placed on forest regeneration there was an increased need for methods of reducing losses to wildlife. The history of forest wildlife damage research, therefore, parallels that of forest land management; after rather austere beginnings, development became predominantly a response to economics. It was not until 1950 that the full time of one scientist was assigned to this important activity. The development of control methods for forest animal damage is a relatively new area of research.

All animal life is dependent upon plants for its existence; forest wildlife is no exception. The removal of seed and foliage of undesirable plants often benefits the land managers; only when the losses *or* injuries are in conflict with man's interest is there damage involved. Unfortunately, the feeding activities of wildlife and the interests of the land managers are often in conflict. Few realize the breadth, scope, and subtilities associated with forest wildlife damage problems. There are not only numerous species of animals involved, but also a myriad of conditions, each combination possessing unique facets. It is a foregone conclusion that an understanding of the conditions is essential to facilitate a solution to any given problem.

Though there are numerous methods of reducing animal damage, all of which have application under some situations, in this discussion emphasis will be placed on the role of chemicals and on western problems. Because of the broadness and complexity of the problem, generalizing is necessary and only brief coverage will be possible. However, an attempt will be made to discuss the use and limitations of various control methods.

There are two and only two approaches to reducing wildlife damage; they are: (1) to reduce the number of animals or (2) to render the item less attractive. Population reduction can either be direct through the use of lethal agents or game management practices, or indirect, through habitat manipulation or by otherwise controlling reproductive rates. Reducing attractiveness or availability can be accomplished by mechanical or chemical barriers or by altering the internal composition of the plant. Changing the land use, such as growing other tree species, might be considered another way of reducing damage by altering attractiveness.

The types of forest damage fall into three broad categories: (1) seed destruction, (2) foliage clipping and browsing, and (3) root and bark injuries. Each type of damage will be considered separately with a discussion of the problem and possible ways of reducing losses.

Seed Destruction

The loss of naturally or artificially disseminated tree seed to wildlife is a major forest problem. Compared with damage to established trees, seed losses are less spectacular but nevertheless extremely important. From the standpoint of cost, direct seeding and the protection of natural seed fall have always appealed to the forest economist. Another important consideration is the time factor; seeding, for example, permits rapid re-establishment of new burns.

One of our shortcomings has been the oversimplification of problems such as seed destruction. Differences in composition of the depredating wildlife populations and the silvicultural requirements of the seed species make each a separate problem. A technique developed for direct seeding Douglas-fir (*Pseudotsuga menziesii*) in western Washington may afford little protection to ponderosa pine (*Pinus ponderosa*) seed in northeastern California or American black walnut (*Juglans nigra*) in Ohio. Let us consider some of the aspects of just these three seeding problems.

Douqlas-fir

Though there are several species of rodents and birds involved in the depredations of Douglas-fir seed, deer mice (*peromyscus* spp.) are responsible for the greatest losses. Early attempts at nullifying their effect were directed toward population reduction followed by the sowing of the tree seed, the assumption being that with an effective bait, control could be achieved and protection assured. With the introduction of compound 1080 and the use of helicopters for aerial dissemination, the goal had been reached, and it appeared that the problem was solved. In the late 1940's baiting and seeding became an operational procedure. Within a short period the futility of the baiting-seeding approach was realized; the dynamics of the rodent populations had not been taken into consideration. Though rodent numbers could rapidly be reduced to negligible levels, the population low was temporary. Hooven (1953) demonstrated that deer mice reinvaded to the center of 500-acre plots within a few weeks following satisfactory reductional control. Multiple baiting and late winter sowing provided little additional benefit. In the fall of 1951 broadcast seeding of chemically treated seed (Spencer, 1952) was attempted for the first time. Success exceeded expectations and led to increased research effort with seed treatments.

The original treatment consisted of soaking the tree seed for 1 hour in a saturated tetramine-acetone solution. This method provided an effective all-weather treatment; deposits of the chemical were left within the hull on the edible portion of the seed. The shortcoming of this treatment was the reduced viability caused by the acetone. Coatings were reverted to in an effort to overcome this loss of viability, however, not without sacrificing rodent protection.

The outer inedible seed coat of conifer seed constitutes a barrier which severely limits the effectiveness of chemical coatings. Chemicals tenaciously attached to seed are discarded by the mice with the hull fragments, whereas chemicals held loosely are more effective but are rapidly lost through weathering. Another factor influencing the effectiveness of coatings is the manner in which the seed is handled by a species or individual animals within a species. Characteristics of the seed and seed hull are also important considerations. For example, hull fragments of small seeded species are more readily ingested by deer mice than hull fragments of larger seed.

Because of these factors the effectiveness of the current endrin seed coating has definite limitations. This treatment has proven most useful west of the Cascades from central Oregon north and further south into northern California along the coast. Effectiveness within this region is primarily a response to the rodent composition and a climate which is generally favorable to germination.

The seed coating (Spencer, 1957) formula called for the blending of four ingredients: (1) a lethal agent, endrin, (2) a fungicide and repellent, TMTD[1]; (3) a coloring agent, aluminum powder; and *(4)* an adhesive, latex 5I2R. Subsequent field studies have not demonstrated an advantage to the use of the TMTD additive for Douglas-fir (Dick, 1958). Cage studies, however, has disclosed an advantage to increasing the endrin concentration. The formulation and mixing procedures are outlined in the formulations section.

Ponderosa Pine

Rodent composition and abundance varies appreciably throughout the western pine region. This variable coupled with less favorable climatic conditions makes ponderosa pine seeding a more provincial problem. In general, however, mice (Peromyscus spp.), chipmunks (Eutamias spp.), and ground squirrels (Citellus spp.) are the animals primarily responsible for seed losses. The endrin coating on ponderosa pine has not proven effective. There are contributing factors such as the number of seed sown, size of the animals involved, and hibernation patterns.

Supplemental population reduction, timed to coincide with the damaging activities of the animals, is generally required. The timing and number of bait applications will, of course, depend upon the circumstances. Stein (1955) reported successful protection of sugar pine seed (Pinus lambertiana) from rodents with three applications of poison bait. Wheat treated with compound 1080 was used in the fall; wheat treated with thallium sulphate was used in early winter, and wheat treated with 1080 was used again in the spring.

It should be realized that recommended baiting procedures differ for each group of rodents. Reductional control directed at one species may not be effective for another. The bait selection and the method of application should

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[1] Tetramethylthiuram disulphide.

take this into consideration. For example, fall baiting, initiated after ground squirrels have gone into hibernation, should be directed toward the control of deer mice. In contrast, early spring baiting should be oriented toward the control of ground squirrels.

Black Walnut

Seeding of black walnut introduces a problem of another type, that of seed removal by game animals. The gray squirrel (*Sciurus carolinensis*) and eastern fox squirrel (*Sciurus niger*), both important to the hunter, are a major factor limiting direct seeding of this most valuable of American forest trees. Game management practices have little application in the alleviation of this problem, and, of course, other reductional methods would not be compatible to all interests. Without an effective chemical repellent treatment mechanical barriers remain the most practical approach. The "tin can" method (American Walnut Manufacturers Association, 1958) is one way of protecting walnut seed from squirrels. To facilitate this method, a number two size can or larger is recommended. First a hole of about I inch in diameter is punched in the bottom of the can. The walnut seed is placed in the can after an inch of soil has been added. The can is then filled with soil and planted vertically with the punched hole end up. Obviously this technique is costly. It has greatest application in the management of farm woodlots or other small forest plots.

Foliage Clipping and Browsing

Clipping and browsing damage starts with emergence of the seedlings which then may persist until vertical growth exceeds the reach of browsing animals. Newly emerged seedlings are especially attractive to mice (Kverno, 1957) and ground squirrels (Stein, 1955). Stems and foliage of larger seedlings are clipped by rabbits and numerous species of rodents and they are browsed by deer and elk. Again the problems are as extensive and as varied as the conditions under which they exist.

Clipping

The codyledons of newly emerged seedlings contain stored food which is used to provide nourishment during part of the plant's early life. For the first few weeks following germination these succulent seedlings are fed upon by most small rodents. Where these losses are severe, reductional control with lethal baits is the only practical solution. Proper bait selection and distribution, timed to coincide with the beginning of germination, will generally afford adequate relief.

Wildlife injuries to existing seedlings is a more obvious type of damage and also one of extreme importance. Stem clipping of newly planted seedlings often results in high mortality. Snowshoe hares (*Lepus americanus*) and mountain beaver (*Aplodontia rufa*) are commonly associated with these losses within the Pacific coast forests. New plantations require about 3 years' protection from hares to insure immunity from damage whereas mountain beaver may constitute a threat for longer periods.

Seedling protection through population reduction has not been entirely satisfactory. Bait acceptance is generally poor, especially prior to the first killing frost, and damage often becomes excessive during the late summer. Though the perishable baits are difficult to work with, fresh apples have proven to be one of the better accepted carriers. Results are appreciably improved by conditioning the animals to the carrier before distributing the treated bait.

Effective contact repellents are available (Besser, 1959) for rabbits, hares, and mountain beaver. Nearly all conifer seedlings from West Coast forest nurseries are sprayed with a TMTD repellent while still in the nursery beds. This foliar repellent effectively reduces clipping damage during the first season, thus permitting the seedlings to become established. Though the repellent film is rather persistent, after a few months its effectiveness is greatly reduced. Also, all new foliage produced subsequent to treatment remains unprotected. Under some field conditions seasonal respraying of new foliage is feasible. Where dense ground cover obscures the seedlings, population reduction is perhaps more practical but not necessarily more effective.

Browsing

Browsing injuries are generally not responsible for a high rate of seedling mortality. These injuries are, however, responsible for retarding growth within plantations and deforming seedlings. The mortality or extent of delaying effect does, of course, depend upon the severity of the damage. Deer (Odocoileus spp.) and elk (Cervus canadinsis) are the two principal animals involved. Elk damage is serious in some areas but is not as extensive as that of deer. Deer damage is almost a universal forestry problem; only the degree of damage varies.

Herd reduction through hunting is a popular approach to the alleviation of big game damage. Though this approach has merit, it is far from the total solution. Reducing big game populations to the holding capacity of their range is good game management. But reducing their numbers to a level where forest damage becomes a negligible factor is not necessarily good management. Often severe damage occurs only during a short period of the year or within a small segment of the total range. Besides the public relations aspect, the law of diminishing returns will dictate hunting pressure and thus limit the effectiveness of this method.

In Europe fencing is often employed to reduce deer damage. It has been suggested as a means of reducing damage within some of the better western pine sites that are subjected to heavy deer pressure. A 30-acre deer exclosure constructed in western Washington at a cost of $1,685 ($56 per acre) was projected by Johnson and Adams (1955) to be only $10.53 per acre when extended to a full square mile. There are few large areas, however, that would lend themselves to fencing. In addition to the obstacles of terrain, multiple ownership, and cost, the approach does not conform to the popular multiple use concept.

Seedling protection with available chemical repellents is another approach with serious limitations. Repellency, which implies a degree of acceptance, is a function of feeding pressure. Effectiveness depends largely upon the number of animals, the availability of other foods, and the desirability of the item to be protected in relation to available food. A repellent can be good under one set of conditions and poor under another. This is especially true for deer because of the wide variety of plants they will accept and their mobility. In brief, there is no single answer to big game damage by browsing. The conditions alone will determine the best approach or approaches to employ.

Root and Bark Injuries

Root injuries are most frequently associated with seedlings or small saplings and pocket gophers are usually the responsible animal. The control of pocket gophers was covered during the 1962 conference and, therefore, will not be discussed here. Bark injuries are by far the most varied in terms of animals and age of trees involved. Meadow mice (Microtus spp.) severely damage seedlings; in contrast, bear are responsible for similar damage to large trees. The porcupine, on the other hand, removes bark from seedlings, saplings, and mature trees. Other animals known to cause bark injuries are mountain beaver, rabbits, wood rats, squirrels, and pocket gophers.

Because of their importance and due to the differences in their damage and the control of it, only the meadow mouse, bear, and porcupine problems will be reviewed.

Meadow Mice

Meadow mice have become a serious problem on many of the retired coastal agricultural lands. Lack of cultivation or grazing has produced a habitat ideally suited to these animals. The thiram repellent will provide partial relief when sprayed or painted on the lower stem. Periodic retreatment is required, and under heavy pressure should be supported by reductional control. Habitat manipulation is another approach that has application with meadow mice. Removal of the vegetative cover with herbicides or through cultivation removes the problem. Meadow mouse damage can be alleviated with available techniques. Their control, however, may require persistent effort for several consecutive years—a price few are willing to pay.

Bear Damage

During the late winter and early spring bears often supplement their diet with the sugar-laden inner bark of young trees. This problem is quite serious in some sections of the coastal forests (Levin, 1954). Reductional control through hunting with dogs, trapping, and snaring has provided local relief from damage. The black bear is considered a game species, but has temporarily been taken off the game list in most of the damage areas. As the recreational status of bears improves and hunting pressure by sportsmen increases, this problem will become less important.

Porcupines

The wide age range and size of trees damaged by porcupines makes them a potential long-term threat in the western pine forests. Their feeding versatility limits the use of mechanical or chemical barriers and makes reductional control the logical approach. In areas where access is not restrictive, hunting alone is often adequate. In the more remote areas or in large forest tracts that have limited access, poisoning is often used to complement hunting activities.

Where porcupines concentrate in rock ledge denning sites during the winter months, as they do in parts of the Northeast, den poisoning is quite successful. Apples treated with sodium arsenite (Dodge, 1959) have proven an effective bait. In the western states where den poisoning is restricted to a few areas, strychnine salt blocks are more frequently used (see formulations section).

Proper placement of the blocks is of extreme importance. To minimize hazard to other animals the blocks should be securely attached and out of reach of deer and livestock. Abandoned buildings provide attractive protected sites. Water courses are also frequently used by porcupines. Where natural ledges are not available it is necessary to construct "bait boxes" to confine the salt blocks. These poison sites are reported to be more effective when baited with animal scents or with the carcass of a porcupine.

Formulations

There are few chemical formulations that were developed for, and *are* being used primarily in, the alleviation of forest wildlife damage. Three operationally used formulas (or modifications thereof) that were developed to alleviate western forestry problems *are* outlined below. It should be realized that all pesticides are potentially hazardous and therefore should be handled only by experienced personnel.

Seed Treatment Formula

Endrin, the active ingredient, is available for seed treatment in a special 50 per cent wettable powder. It is suggested that this endrin mixture be employed at 2 per cent (1 per cent active) the weight of the seed. An adhesive proven to be effective is Dow latex 512R.[2] The latex, just prior to use, should be diluted at the ratio of one part latex to nine parts of water. The amount of adhesive will be determined by the size and purity (surface area) of the seed being treated (less than 1 quart for 20 pounds of Douglas-fir). The minimum quantity of adhesive required to give adequate coverage should be employed. The addition of aluminum powder pigment (at about the rate of 1 per cent the weight of the seed) will serve as a visual aid in determining coverage during mixing and will also act as a visual reminder that the seed is treated with a toxic compound.

The three ingredients, endrin, adhesive, and pigment, should be mixed thoroughly by shaking in a capped container or in an electric blender. This slurry is then poured over the seed as it; is being stirred, tumbled, or mixed. Since a minimum of liquid is used, the formula sets up rapidly (within 2 or 3 minutes). Once uniform coverage is attained, mixing should be stooped. Small cement mixers have proven adequate for treating large amounts of seed. They will handle single batches of 20 to 25 pounds of Douglas-fir seed.

[2] **Trade names referred to in this publication do not imply government endorsement of commercial products.**

TMTD Foliar Repellent

Commercial sources of the thiram repellent are available. However, formulating the material is relatively simple once the ingredients have been acquired. Arasan 42-S (42 per cent TMTD) is a preferred source of TMTD. Except for water, the only other required ingredient is the adhesive, Rhoplex AC-33 (48 per cent solids). For field use an aqueous suspension is prepared which contains 10 per cent by weight TMTD and 10 per cent by weight Rhoplex. These percentages are computed on a dry solids basis. Preparation of a 20 per cent concentrate improves the suspending quality of the formulation. The concentrate is then diluted with water to the desired strength prior to use.

Strychnine Porcupine Blocks

The blocks are prepared by adding 1 ounce of strychnine alkaloid and 1/4 ounce of magnesium carbonate to each pound of crystallized table salt. Once these ingredients are thoroughly mixed a small amount of water (about 1 gallon water to 100 pounds of salt) is added. The mixing is continued until the consistency of the mass is uniform. This mixture is then placed into holes cut in white pine blocks and permitted to dry. The blocks are prepared from 5-inch sections of clear 2 x 4 lumber. Three-quarter inch holes are drilled into the edge of the blocks to provide a slot of about 3/4 inches wide, 1-1/4 inches deep, and 3-1/2 inches long. Along each edge a 1/8-inch hole is drilled to attach the blocks to the bait site. The word "POISON" should be burned into the side of each block.

Summary

As the demand for forest products continues to increase, the influence of forest wildlife damage becomes more important. The development of control methods for the alleviation of forest damage is a relatively new area of research. Though there are numerous approaches to the animal damage problems, research emphasis has been placed on the search for and the development of useful chemical formulations.

The breadth, scope, and subtilities associated with forest wildlife damage problems are seldom realized. Not only are there numerous species of animals involved, but there is also a myriad of conditions, each combination possessing unique facets. The methods currently available for reducing animal damage have limited application. Chemical treatments for seed protection are only effective in a few areas. Likewise, chemical repellents are only moderately effective for some animal species.

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