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ANIMAL DAMAGE PROBLEMS AND CONTROL ACTIVITIES ON NATIONAL FOREST SYSTEM LANDS

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ABSTRACT: A questionnaire survey of the National Forests in 1988 indicated that animal damage control (ADC) was conducted on 208,000 acres of reforestation and older stands, nearly all in the West, at a cost of about \$9 million. Sixty-two percent of the total acreage treated, or 128,600 acres, and 49 percent of the ADC costs, or \$4.3 million, was in the Pacific Northwest Region (Oregon and Washington). Most of the forests in all regions of the Forest Service, except Alaska, rated animal damage to reforestation and older stands as very important or moderately important. One-third of the forests rated damage as increasing, about two-thirds rated damage as about the same, and only 6 percent rated it as decreasing. Damage to forest stands was caused by a wide variety of animals, including livestock, but pocket gophers (*Thomomys* sp.) were the single most destructive group of species on National Forest System (NFS) lands. More than half the forests reported animal damage to structures and campgrounds or animal-related health hazards such as rodent-borne diseases. Beaver (*Castor canadensis*) were a minor problem in all regions and were reported as causing damage by about one-third of the forests. In addition to significant and increasing black bear (*Ursus americanus*) damage to young stands, bear depredations and nuisances were reported by half of the forests in all regions except Alaska. Two-thirds of the forests reported an ongoing need for ADC training. Forests reported ADC research needs in every region except Alaska.

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INTRODUCTION

Animal damage has been recognized as a hazard to forest regeneration and other resources on the 191 million acres of National Forest System (NFS) lands from the beginning of regeneration efforts in the early 1900s. (The 156 National Forests are managed as 123 administrative units in 9 regions, Figure 1.) During stand development, conifer seeds, seedlings, saplings, and older trees are subject to various kinds of damage by many animals. Animal feeding causes most injuries to forest trees and results in seed destruction, cone severing, browsing, clipping, budding, seedling pulling, tree cutting, and barking. Other injuries, mainly from trampling and rubbing, are caused by large animals. Moore (1940) identified animals causing damage to forest plantations in the Pacific Northwest and described the types of damage caused by each species. Lawrence et al. (1961) illustrated the types of feeding injuries caused by these animals in a popular and widely used guide to wildlife damage identification. Soon after large-scale artificial regeneration began in the 1940s, the need to protect tree seeds and seedlings from animals became evident (Looney 1969).

Numerous studies and surveys were conducted, particularly in the Pacific Northwest, to determine the extent of animal damage problems and their control. One of the most comprehensive, the cooperative survey of animal damage to coniferous plantations in Oregon and Washington (Black et al. 1979, Brodie et al. 1979), evaluates the impact of animal damage on survival and growth of Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) plantations established in 1963-64, then observed for 5 to 10 years. (About 40 percent of the plantations surveyed were on NFS lands.) Browsing by deer (*Odocoileus* sp.) and elk (*Cervus* sp.) and clipping by hares (*Lepus* sp.), rabbits (*Sylvilagus* sp.), pocket gophers (*Thomomys* sp.), and other rodents occurred extensively and repeatedly during stand establishment. This damage caused significant tree mortality and reduced height

growth. An economic evaluation of these data (Brodie et al. 1979) showed that losses from animal damage were substantial, even with allowance for wide fluctuation in impacts of damage.

Other surveys in Oregon and Washington in the 1970s were aimed at determining the nature and extent of problems caused by porcupine (*Erethizon dorsatum*) (Evans and Matthews 1972), pocket gophers (Northwest Forest Pocket Gopher Committee 1976), and mountain beaver (*Aplodontia rufa*) (Mountain Beaver Subcommittee, Northwest Forest-Animal Damage Committee 1979). National Forests were an important part of the areas surveyed, which included public and private commercial forest lands. These surveys confirmed that damage caused by these species was widespread, significant, and increasing; for example, owners and managers of forest lands in Oregon, Washington, and northern California reported mountain beaver damage on about 275,000 acres in 1977, including about 70,000 acres of NFS lands.

In the late 1960s, Crouch (1969) made the first comprehensive assessment of animal damage on NFS lands. Although limited to the National Forests of the Pacific Northwest Region (Oregon and Washington), this questionnaire survey provided a detailed description of the kinds of injuries occurring on NFS lands and the animals causing them. Foliage browsing was the most common type of damage, followed in order by barking, root gnawing, clipping, trampling, and loss of trees. Problem animals in order of importance were deer, porcupine, pocket gophers, hares and rabbits, elk, livestock, small rodents, mountain beaver, and bear (*Ursus americanus*). Animal damage was more common on National Forests in Oregon than in Washington and most problem areas were in western Oregon. Crouch noted that in 1969 about 25 percent of all reforestation work in the region had to be redone, principally because of animal damage.

The Forest Service
United States Department of Agriculture

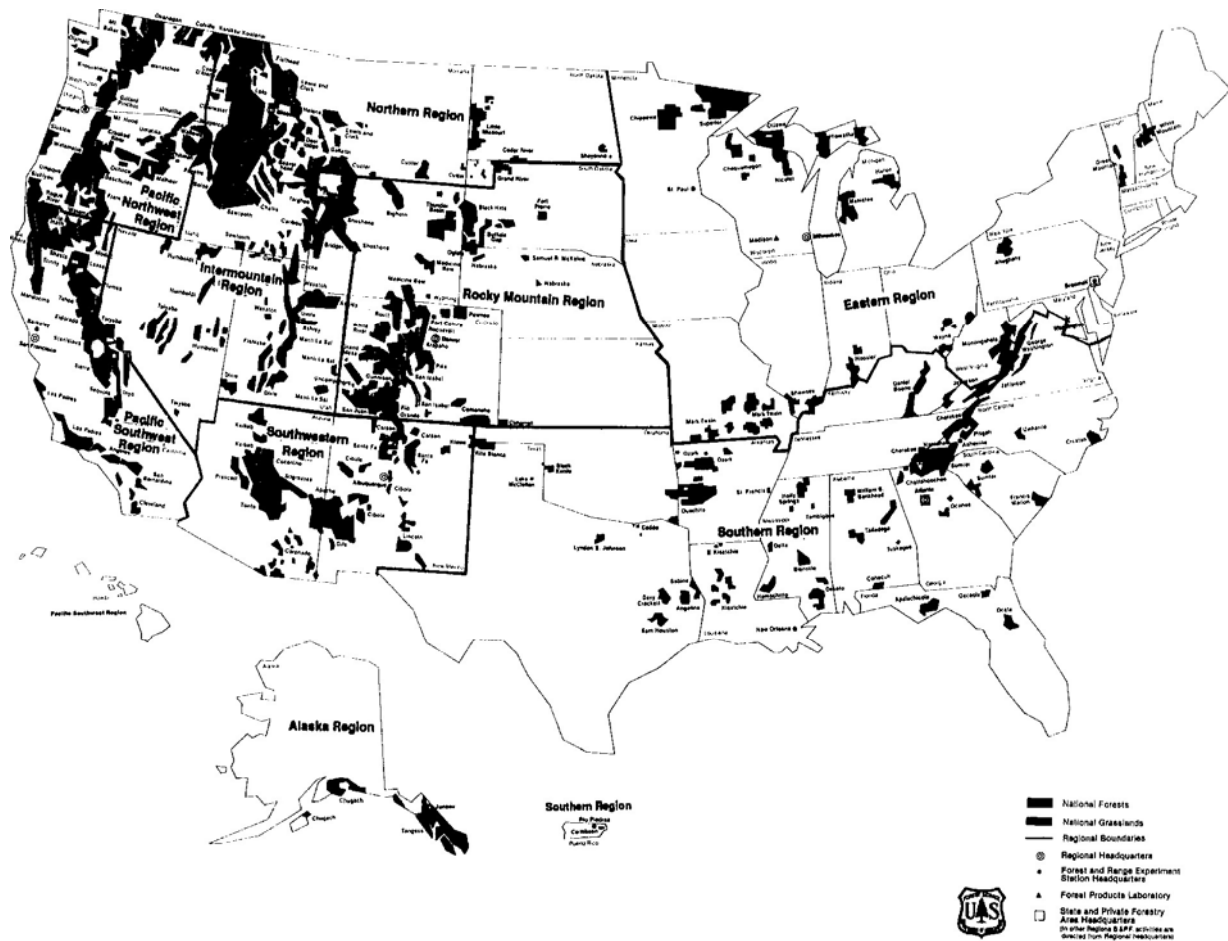


Figure 1. National Forests and administrative Regions of the National Forest System.

In 1984, the Forest Service conducted a limited questionnaire survey of animal damage on NFS lands in four western regions (Northern, Rocky Mountain, Pacific Southwest, and Pacific Northwest) and of animal damage control (ADC) research at all Forest Service Research Stations (2470 Silvicultural Practices, unpublished report dated March 25, 1984, from Director of Timber Management to Deputy Chief NFS). (About half of all reforestation on NFS lands is accomplished in the Southern and the Eastern Regions, but animal damage in the East is minor compared with that in the Western Regions except Alaska.) This survey was undertaken to provide a current assessment of ADC activities on NFS lands. Timely information was needed to assess the importance and priority of ADC work in response to proposals before Congress to transfer the Federal ADC program from the U.S. Department of the Interior, Fish and Wildlife Service, to the U.S. Department of Agriculture. (The Animal and Plant Health Inspection Service (APHIS) took over the animal damage control program from the Fish and Wildlife Service in December 1985.) Although limited to those regions where most of the animal damage was

occurring, the survey showed that animal damage was a serious problem to forest regeneration and other resources. For example, the Northern Region reported that animal damage, chiefly by pocket gophers, was the major cause of plantation failure from 1976 to 1983. The principal causes of damage in order of importance were pocket gophers, big game (deer and elk), hares and rabbits, voles (*Microtus* sp.), porcupines, and mice.

In 1984, National Forests in these four regions conducted ADC to protect trees on about 100,000 acres. Direct control costs exceeded \$5.5 million. An additional 8 to 10,000 acres required replanting, principally because of animal damage, at an additional cost of \$3.5 million. The Research Stations reported little or no ADC research under way or planned. All four regions indicated that more ADC research was needed to develop improved methods for controlling pocket gopher damage.

Two regional assessments of animal damage in the 1980s provided in-depth analyses of animal damage to conifer regeneration in southwestern Oregon (Evans et al. 1981) and western Oregon (Campbell and Evans 1984). The 1981 study

emphasized the need to quantify the impact that animals have on forest regeneration. The 1984 study, which was based on a survey of more than 100,000 acres of reforested public and private commercial forest lands, provides an excellent synthesis of published information and operational experience in ADC in the region. It also includes specific information regarding animal damage and control practices followed on NFS lands in western Oregon.

Numerous other state or regional surveys of animal damage on forest lands have been made such as an annual questionnaire survey of state, federal, and private foresters, companies, and agencies in California (Guisti and Schmidt 1989). To one survey conducted by the California Forest Pest Council's Animal Damage Committee in 1989, respondents reported animal damage on 252,000 acres of forest land, including 36,500 acres of NFS lands. They indicated that animal damage was about the same as in 1988 or increasing.

PROCEDURES

To provide a comprehensive, up-to-date assessment of animal damage control problems and needs on NFS lands, we prepared a detailed questionnaire to be completed by each National Forest. The questionnaire contained 15 questions, each requiring multiple answers. We particularly wanted to determine the extent of animal damage to reforestation and older stands, treatment costs, species causing damage, and control practices followed on each forest. Other questions asked about (1) an assessment of the significance and trend in animal damage; (2) identification of other types of animal damage or animal-related health hazards such as rodent-borne diseases; (3) predator or nuisance control; (4) ADC training and technical assistance needs; and (5) ADC research needs. The questionnaires were distributed to the regions and the forests in November-December 1988. Forest silviculturists and wildlife biologists took the lead in completing the questionnaires, but we requested that responses to the questions be coordinated among the several staff groups concerned with ADC on each forest.

RESULTS

All the questionnaires were completed and returned by the forests. Forests with significant animal damage problems generally provided the most detailed responses and comments. Most of the data reported were for fiscal year 1988.

For analytic purposes, responses to each question were tabulated by regions. (The NFS is subdivided into nine regions.) Data for the Alaska Region were omitted from these summaries because animal damage problems are minor and scattered on the two National Forests in the region.

Extent of Animal Damage to Forest Stands

In 1988, animal damage control on NFS lands was conducted on 57,425 acres of new plantations, 128,668 acres of plantations 1 to 10 years old, 6,452 acres of precommercially thinned stands, and 15,704 acres of other older stands (Figure 2). In all, 208,199 acres were treated for ADC at a cost of nearly \$9 million in 1988 (Figure 3). Sixty-two percent of the total acreage treated, or 128,621 acres, was in the Pacific Northwest Region (Oregon and Washington); 49 percent of the ADC costs, or \$4.3 million, was in the region. (No attempt was made to estimate the amount or cost of replanting required because of animal damage.) Animal damage control treatment costs averaged about \$57 per acre for new plantations, \$42 per acre for 1-

to 10-year-old plantations, and \$7-8 per acre for precommercially thinned and other stands.

In 1988, the USDA Forest Service reforested 416,100 acres and accomplished timber stand improvement (thinning, fertilization, etc.) on an additional 337,200 acres (USDA Forest Service 1989). An additional 36,800 acres were reforested by natural regeneration. Reforestation by direct seeding was negligible. In all, roughly one-quarter (28%) of all reforestation and timber stand improvements was treated for ADC.

Although significant acreage of NFS rangelands and forested grazing allotments was identified as needing ADC treatment (about 60,000 acres), only about 4,000 acres were treated in 1988, at an average cost of about \$16 per acre or \$61,000. Most of this work was done in the Northern and Rocky Mountain Regions. Pocket gophers, ground squirrels, and prairie dogs (*Cynomys* sp.) caused most of the damage to rangelands and forested grazing allotments.

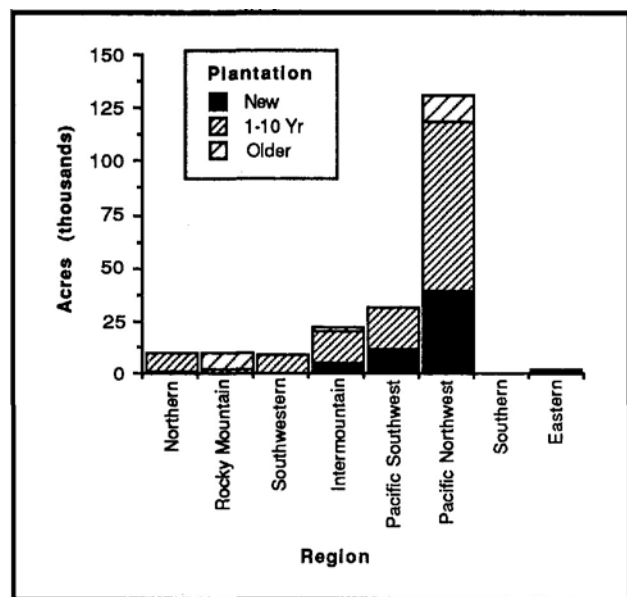


Figure 2. Acres treated for animal damage control in 1988 by forest stand category and National Forest System Region.

Most of the forests (79%) in all regions of the Forest Service, except Alaska, rated animal damage to reforestation and older stands as very important or moderately important. One-third (35%) of the forests rated damage as increasing, nearly two-thirds (59%) rated damage about the same, and only 6 percent rated it as decreasing. Among reasons cited for the increasing trend in animal damage was the increased number of stands (and acres) of new plantations and young stands, the age classes (seedlings and small saplings) most vulnerable to animal damage. Reforestation increased because of higher timber harvest and more wildfires.

Species Causing Damage to Forest Stands and Control Practices

Species causing damage by number of forests reporting were deer (65%), pocket gophers (64%), livestock (mainly cattle) (47%), elk (36%), porcupine (35%), and hares and rabbits (32%). Deer and hares and rabbits were the only

damage agents reported by one or more forests in all regions. More than half of the forests in the western regions (60%) reported damage by livestock to forest plantations. Pocket gopher and porcupine damage also was widely distributed and reported by forests in all regions except the South. Other species reported as causing damage by number of forests reporting were beaver (*Castor canadensis*) (12%), voles (11%), black bear (10%), mountain beaver (10%), tree squirrels (*Sciurus* sp.) (9%), ground squirrels (*Spermophilus* sp.) (8%), grouse (*Dendragapus* sp.) (3%), woodrat (*Neotoma fuscipes*) (woodrat and all others 1%), moose (*Alces alces*), feral burro (*Equus asinus*), and yellow-bellied sapsucker (*Sphyrapicus varius*).

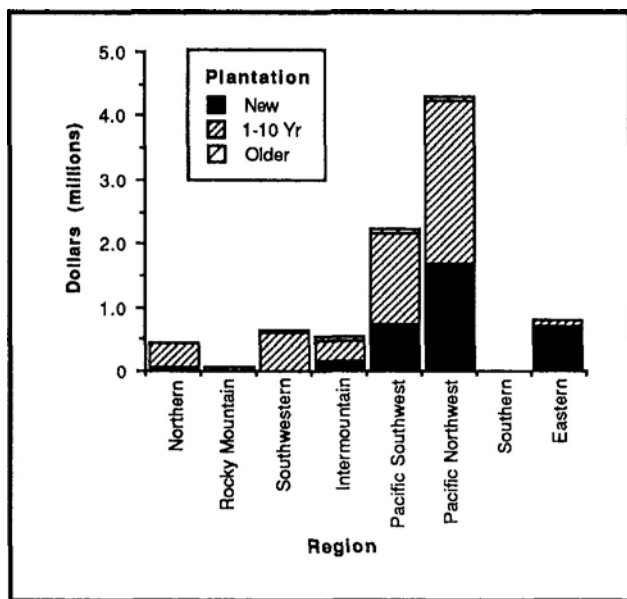


Figure 3. Cost in 1988 of animal damage control for reforestation and stand management by stand category and National Forest System Region.

Eleven of the 16 forests in the Intermountain Region reported browsing and trampling damage by livestock, and half indicated that this type of damage was increasing. Fencing was the principal means of protecting plantations from livestock. In all, forests in this region constructed 27 miles of fencing and maintained 138 miles of existing fencing to protect plantations from livestock on grazing allotments in 1988, at a cost of \$172,000. An additional \$84,000 was expended to replant 168 acres destroyed by livestock.

Control practices to limit damage by deer and elk included using rigid plastic tubing, repellents such as Big-Game Repellent (BGR) (mention of a commercial or proprietary product does not constitute endorsement by the USDA), netting, bud caps, habitat modification, and special hunts. Pocket gophers, the most destructive group of species on NFS lands, were controlled mainly by hand- or machine-baiting with strychnine-treated grain baits. Habitat modification, planting of above-normal numbers of seedlings, and plastic tubing to protect seedlings above- and below-ground were also used. Plantations were protected from livestock by fencing, including electric fencing, and

herding practices. Repellents, such as Thiram, plastic tubing, and habitat modification were used to protect seedlings and saplings from clipping by hares and rabbits.

The Allegheny National Forest, Pennsylvania, used aerial fertilization of cutover areas to control deer damage to hardwood regeneration. The fertilizer promoted rapid growth, which enabled the seedlings to better sustain heavy browsing and to rapidly grow out of reach of deer. The forest fertilized 2,300 acres at an average cost of \$250 per acre to control animal damage in 1988.

Porcupine control was accomplished by private contractors, APHIS-ADC, or forest personnel. Several forests that have a history of porcupine damage to ponderosa pine and other conifer plantations maintain ongoing control programs. For example, the Deschutes National Forest, Oregon, took 1,050 porcupines by shooting in 1988, at a cost of \$14 per animal, in an effort to control porcupine damage to pine plantations. The Umatilla National Forest, Oregon, is another example of a forest with a history of extensive porcupine damage to ponderosa pine plantations. Tree killing (girdling) was severe enough in several instances to require replanting. Other damaged trees developed multiple tops or stem deformities, or stem-barking injuries exposed trees to insect and disease attack. In response to this problem, the forest developed a unique cooperative agreement with an adjacent industrial timberland owner (Kinzua Corporation) for joint porcupine control on the forest and adjoining commercial timberland. The porcupine management plan calls for taking up to 1,500 porcupines during the first year (1989) of the 5-year agreement at an estimated cost of about \$10 per animal.

Other Types of Animal Damage

More than half of the forests (54%) reported other types of animal damage in 1988 such as rodent-borne diseases, ground squirrel damage to campgrounds, rodents burrowing into banks or dams, etc. Species causing damage by number of forests reporting included beaver (39%), ground squirrels (23%), pocket gophers (4%), porcupine (4%), muskrat (*Ondatra zibethica*) (3%), marmots (*Marmota* sp.) (marmots and all others 1%), woodchuck (*Marmota monax*), prairie dogs, moles (*Scapanus* sp.), skunks (*Mephitis mephitis* and *Spilogale putorius*), badger (*Taxidea taxus*), mice, feral hogs (*Sus scrofa*), deer and elk, and woodpeckers (*Picidae*). A very conservative estimate of control costs for these types of damage was \$136,000 in 1988.

An indication of how low this estimate may be is shown by comparing it with results of a questionnaire survey of forest managers and natural resource agencies in 16 southern states (Miller 1987). Respondents estimated that annual wildlife damage to forest resources was more than \$11 million, with another \$1.6 million annual expenditure to prevent or control damage to forest lands. They reported that beaver caused the most damage to forest resources in the South by flooding plantations, girdling and cutting trees, and flooding roads and other structures. (All the National Forests in the Southern Region participated in this survey.)

Beaver were a significant problem in all regions and were reported as causing damage by more than one-third (39%) of the forests. Problems mainly involved plugging of culverts and pond spillways, which caused flooding of roads and plantations and damage to trout streams due to excessive siltation. Beaver are an especially common problem on forests in both the Eastern and Southern Regions and are the most common

animal damage problem in the South where control is often difficult because of the intermingled pattern of private and public ownership. On the National Forests in Florida, for example, it cost \$4,000 to trap and remove beavers to control flooding of a 110-acre plantation and adjoining roads in 1988.

In the Lake States, beaver are causing minor damage problems, particularly to trout streams. The Nicolet National Forest, Wisconsin, contracts with APHIS to maintain trout habitat by removing beaver from high-quality trout streams. In all, beaver control costs the forest about \$30,000 per year. On the Chequamegon National Forest, Wisconsin, problem beaver are removed by contract at a cost of about \$25 per animal; the annual beaver control program costs about \$2,000 per year. The Chequamegon National Forest also uses habitat modification in riparian areas as a long-term solution to alleviate beaver damage. Riparian aspen stands are converted to less favorable habitat for beaver by planting spruce (*Picea* sp.) or balsam fir (*Abies* sp.). On the Hiawatha National Forest, Michigan, beaver damage mainly involves flooding of roads and siltation of trout streams (thereby impeding trout access to spawning areas). Beaver control is conducted in cooperation with the Michigan Trapper's Association and costs about \$4,000 per year.

On the Uinta National Forest, Utah, the State Department of Natural Resources provided assistance to the forest in trapping nuisance beavers in and around campgrounds and their water systems.

Predator Control

Species causing problems by number of forests reporting were black bear (46%), coyote (*Canis latrans*) (34%), mountain lion (*Felis concolor*) (18%), bobcat (*Felis rufus*) (3%), grizzly bear (*Ursus horribilis*) (2%), and golden eagle (*Aquila chrysaetos*) (1%). Control was undertaken for two principal reasons: livestock depredations and nuisances by bears in campgrounds. Predator control on NFS lands was conducted primarily by State Fish and Wildlife agencies or APHIS, or both, in cooperation with the Forest Service. No attempts were made to assess livestock losses or cost of predator control.

In addition to significant and increasing bear damage to young stands, black bear depredations or nuisances were reported by about half (46%) of the forests and in all regions except Alaska. This type of problem was most common on forests in the Intermountain and Pacific Southwest Regions. In most instances, black bears in campgrounds or similar situations were live-trapped and removed.

Other Animal Damage Control Practices

Models to predict animal damage were used by most of the forests (67%) in the Pacific Northwest Region. They reported using models to predict damage by deer, elk, pocket gophers, mountain beaver, and black bear. Only a few of the forests in the other regions reported using animal-damage prediction models, although most forests (53%) indicated a need for such models and for better information regarding benefit-cost ratios of ADC.

Nearly all the forests (89%) reported that an Environmental Assessment (EA) or Environmental Impact Statement (EIS) was accomplished before conducting ADC involving use of pesticides or direct population control.

Animal Damage Control Training

Two-thirds of the forests (67%) reported an ongoing need for ADC training, particularly because of turnover in personnel and lack of ADC experience among new employees.

Several forests indicated that basic ADC training in damage identification and application of ADC practices was most important. But the need for training in all phases of ADC was identified: field identification of animal damage (type and damage agent), damage prediction, benefit-cost analysis, and application of ADC practices. Other ADC training needs identified included development of up-to-date field guides, slide-tapes, and videos on ADC. Training in ADC also may be needed for certification of pesticide applicators.

Two-thirds (63%) of the forests reported that there was sufficient information available to adequately assess animal damage, but only half (50%) reported sufficient technical information available for cost-effective control.

One-third of the forests (35%) indicated a need for more technical assistance in assessment and management of animal damage, even though APHIS, State Fish and Wildlife agencies, and others are providing technical assistance and actively cooperating with forests in ADC.

Animal Damage Control Research

Twenty-four forests reported conducting research related to ADC in cooperation with Forest Service Research Stations, universities, APHIS Science and Technology, or ADC administrative studies (applied studies, limited in scope, and conducted mainly by forest personnel). The following are examples of current studies:

1. The Targhee National Forest, Idaho, is cooperating with APHIS Science and Technology, Olympia, Washington, in efficacy studies of strychnine-treated oat baits to control pocket gophers. The Modoc National Forest, California, and the Pacific Southwest Research Station are conducting a cooperative study of the effects of simulated grazing and stubble height on tree growth, herbaceous vegetation, soils, and animal damage in young conifer plantations.
2. The Eldorado, Klamath, Sequoia, Shasta-Trinity, Stanislaus, and Tahoe National Forests, California, are cooperating with the University of California, Davis, in a study of the efficacy and environmental exposure of multikill strychnine baits to control pocket gophers.
3. The Fremont, Rogue River, and Winema National Forests, Oregon, in cooperation with APHIS Science and Technology, Olympia, Washington, are conducting an administrative study of the efficacy of anticoagulant bait blocks for pocket gopher control.
4. The Suislaw National Forest, Oregon, is cooperating with the Oregon Forest Industries Council, the U.S. Department of the Interior, Bureau of Land Management, and Oregon State University in a study of habitat use by black bear in relation to Douglas-fir damage.
5. The Umatilla National Forest, Oregon, in cooperation with Bell Laboratories, Madison, Wisconsin, is conducting efficacy tests of cholecalciferol (vitamin D₃) to control pocket gophers.
6. The Allegheny National Forest, Pennsylvania, is cooperating with the Northeast Research Station in a study of the effects of deer densities, under different levels of timber harvest, on hardwood regeneration.

Animal Damage Control Research Needs

Forests reported ADC research needs in every region except Alaska. The following are some of the principal needs reported:

1. Northern and Pacific Northwest Regions--study the

effects of deer and elk browsing on yield from managed forests; develop animal damage prediction models for black bear.

2. Rocky Mountain and Southwestern Regions--develop inexpensive methods to keep livestock out of new plantations.
3. Intermountain Region--study the effects of herbicides and other vegetative management practices on pocket gopher damage to conifer plantations; study the effects of prescribed grazing on conifer plantations; develop more effective and socially acceptable methods of porcupine damage control.
4. Pacific Southwest Region--study the effects of deer browsing on growth and yield from managed forests; develop improved methods of animal damage management.
5. Pacific Northwest Region--study the effects of deer and elk browsing on yield and usage of plantation sites; evaluate the effectiveness of forage seeding to reduce deer and elk browsing on Douglas-fir plantations; study the effects on animal habitat and usage of plantation sites of prescribed burning versus no burning during site preparation.
6. Southern Region--study the effects of deer browsing on advanced oak regeneration.
7. Eastern Region--study the effects of deer browsing in the northern white cedar (*Thuja occidentalis*) type.

DISCUSSION

In comparing results of the 1984 and 1988 questionnaire surveys of NFS lands (based on only four western regions), we find that the acres treated for ADC nearly doubled in 1988, from about 100,000 acres to 187,438 acres, and the cost for ADC treatment increased by about \$2 million for forests in the four regions, or from \$5.5 million to \$7.5 million. The amount of reforestation increased only about 10 percent during this period, however.

Although deer were reported most frequently by forests as causing damage in 1988, pocket gophers were rated overwhelmingly as the most important damage agent in both surveys. Livestock were recognized as a much more important source of damage to plantations in 1988 than they were in 1984, particularly in the Intermountain Region. Black bear also were rated as a more important source of damage to young stands in 1988 than in 1984 and were of growing concern to managers in all the western regions.

Some managers tended to minimize the importance of animal damage because of improved regeneration success. In 1987 (the latest year for which data are available), the reforestation success on NFS lands was 93 percent (USDA Forest Service 1989).

Most forest managers agreed that animal damage is a significant and growing problem. Management of animal damage is also becoming more difficult and costly because of environmental restrictions and public opposition to use of certain ADC tools and techniques, especially pesticides and some direct population-reduction methods. Managers repeatedly voiced the need for more research to evaluate the effects of animal damage and to develop more effective and environmentally acceptable methods for preventing or controlling animal damage.

The most promising development is the growing emphasis on improved silvicultural and vegetation management practices to prevent or limit animal damage. Clearly, ADC requires

organizational commitment and persistent and timely coordination of all regeneration and stand management practices.

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