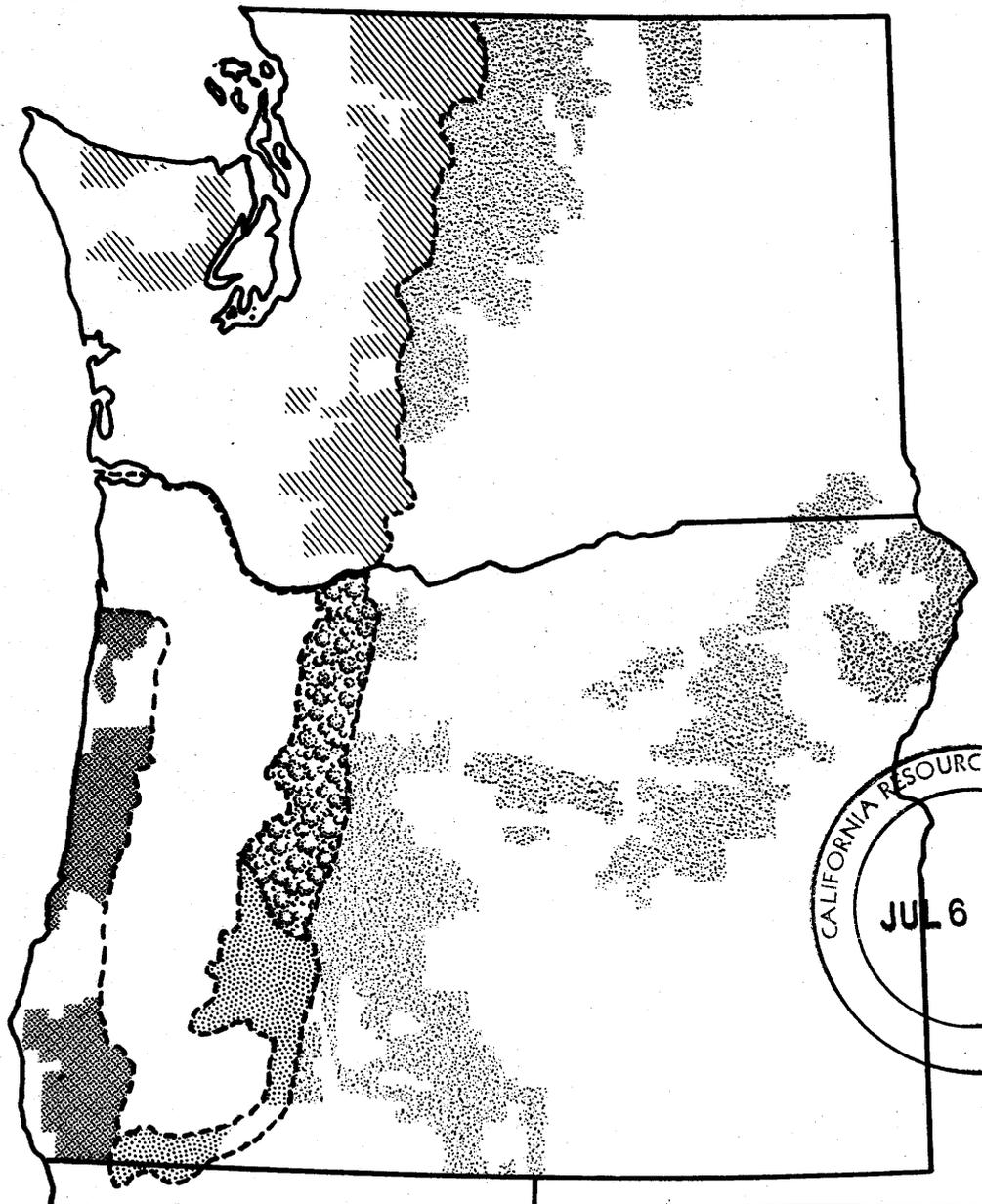


For animal

Animal Damage to Conifers on National Forests in the Pacific Northwest Region...



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by
Glenn L. Crouch 7

DATE E



This study was conducted with the approval and cooperation of the Regional Forester, Pacific Northwest Region.

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CALIFORNIA RESOURCES AGENCY
Reforestation Division
1400 - 9th Street
Sacramento, California
95814

INTRODUCTION

Animal damage to conifers is a timely topic in the Pacific Northwest. Foresters in this Region are increasingly concerned and perplexed by damage caused by animals to natural and planted seedlings and larger growing stock. Nearly every animal inhabiting forest land is believed to injure seedlings and small trees to some degree. Mice^{1/} girdle small trees, and bears girdle larger ones. Pocket gophers pull seedlings down into their burrows, and elk pull them up out of the ground. Hare and rabbits clip trees near the soil surface, and mountain beaver cut them several feet up the stem.

At present, animal-conifer relationships are ill defined and poorly understood. Nevertheless, these relationships are of great importance to foresters working on areas where animals prevent individual trees and stands of trees from producing maximum crops of wood products.

This study was conducted to provide a current assessment of animal-conifer problems on National Forests in the Pacific Northwest Region. Its basic objective was to compile animal damage information available at the field level pertaining to (1) kinds of damage being incurred, (2) species of animals causing damage, (3) locations of problems, and (4) related management factors. In addition, information was sought about problem-area site conditions that might be used to develop useful animal-site relationships.

METHODS

To assemble information on the kinds of injuries and animals causing them on National Forests, we prepared and mailed questionnaires to all Ranger Districts in the Pacific Northwest Region. Each District received 10 copies of the questionnaire, and we asked that appropriate timber and wildlife management personnel prepare one copy for each of the 10 most troublesome animal-conifer problem areas on their District. A problem area was described as one clearcut, plantation, or similar definable unit, preferably less than 100 acres in size. For their answers, District personnel were instructed to consult available office records but not to undertake additional fieldwork to obtain information.

Questionnaires contained 34 questions, some of which required multiple answers. Subject matter groupings were as follows:

<u>Category</u>	<u>Number of questions</u>
Legal and administrative descriptions	5
Animal damage	5
Descriptive site factors	14
Deforestation	7
Reforestation	3

^{1/} Scientific names of animals are given on page 6.

We expected to receive sizable numbers of replies to 20 of the questions and that answers to the remainder would be variable, depending upon the importance of animal damage to the overall workload of individual Districts.

RESULTS

A total of 1,080 questionnaires were mailed, and 587 or 55 percent were returned as shown by the following tabulation:

<u>Area</u>	<u>Number mailed</u>	<u>Number returned</u>	<u>Percent returned</u>
West side:			
Western Washington	220	121	55
West-central Cascades	140	110	79
Southern Cascades	120	96	80
Oregon coast	<u>100</u>	<u>81</u>	<u>81</u>
Total	580	408	70
East side	500	179	36
Region:			
Washington	350	151	43
Oregon	<u>730</u>	<u>436</u>	<u>60</u>
Total	1,080	587	55

Responses were received from every District in the Region. Numbers of returned questionnaires per District varied from 10 to none. Some Districts where problems were acute expressed difficulty in selecting only 10 areas to report.

In general, responses to the basic 20 questions were adequate to permit their inclusion in an overall regional analysis. Numbers of replies to the remainder were variable as expected. Questions about site conditions on problem areas elicited the poorest responses but nevertheless, in many instances, provided usable information. For analysis, each returned questionnaire was given equal weight, regardless of the size of the problem area described or severity of damage. Percentages shown in tables and figures were derived by dividing replies in a question category by the total number of replies to that question.

As a first step in data analysis, replies were grouped according to five geographic subregions having relatively similar problems and problem area types (fig. 1). In addition; problem areas were classified according to their location east or west of the Cascade Range crest. Results summarized in table 1 show that the return rate was highest in western Oregon, intermediate in western Washington, and lowest on east-side forests. Logical interpretation of these values suggests that incidence of animal damage is higher on west-side forests, particularly in Oregon, and lower on the east side. On a statewide basis, animal problems on National Forests appear to be more important in Oregon than in Washington.

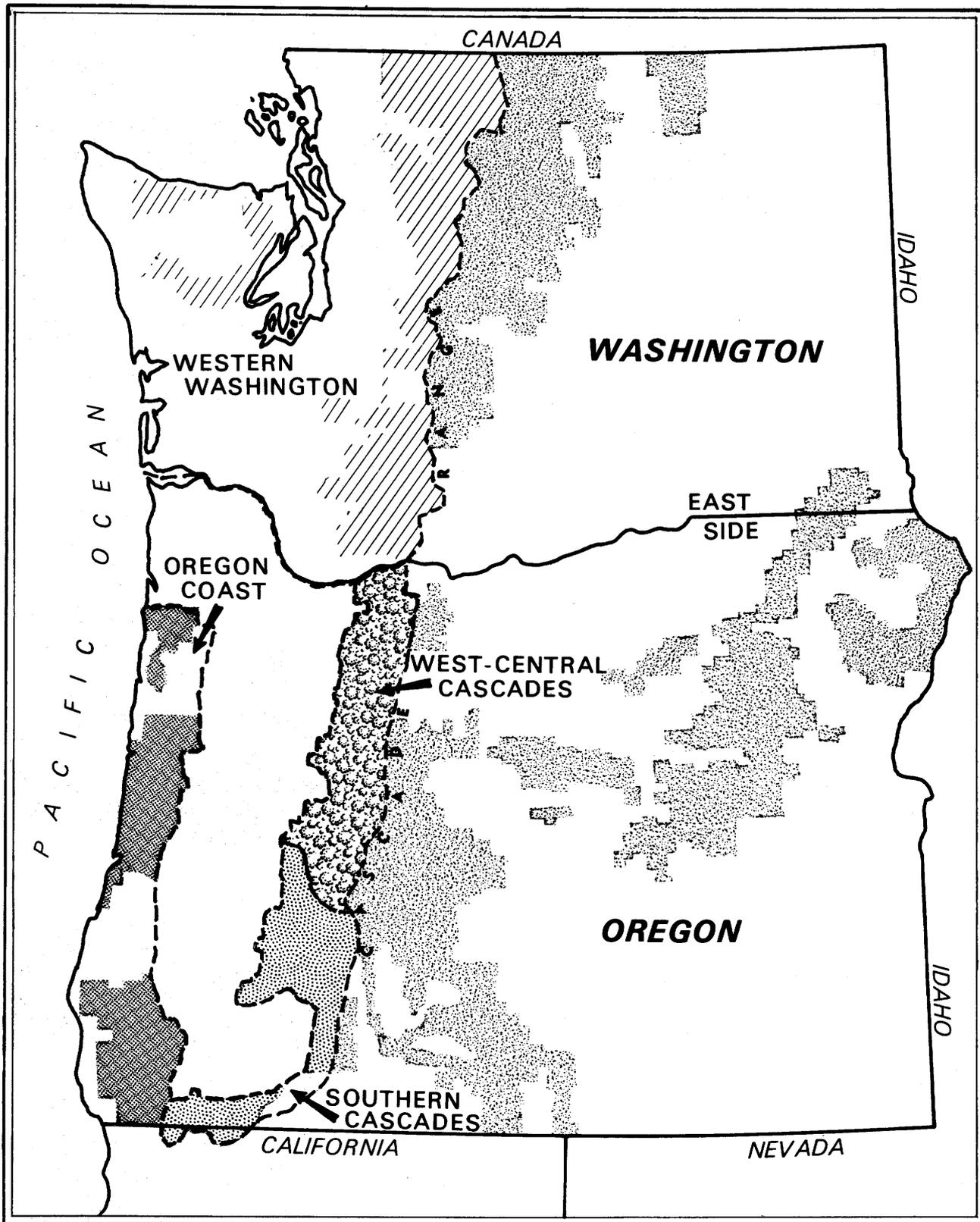


Figure 1.--Geographic distribution of subregions.

Table 1.--*Geographic distribution of replies by problem types reported*

Area	Foliage browsing	Stem barking	Root gnawing	Stem clipping	Tramp- ling	Tree loss	Other
----- <u>Percent</u> -----							
West side:							
Western Washington	62	26	0	31	6	0	2
West-central Cascades	68	26	8	9	3	0	0
Southern Cascades	38	47	24	15	13	0	0
Oregon coast	91	9	0	36	10	0	1
Weighted average	64	28	19	22	7	0	1
East side							
	51	39	43	13	6	5	1
Region:							
Washington	56	31	5	25	7	0	1
Oregon	61	31	23	17	7	2	1
Weighted average	60	31	19	19	7	1	1

KINDS OF PROBLEMS

Problem types are shown in table 1. Browsing was the most common problem regionwide. Browsing was also the most frequently reported injury in each geographic area except the southern Cascades. The browsing category includes foliage removal by deer, elk, and livestock.

Regionally, barking was second in importance. Barking includes fraying, girdling, and bark removal by porcupine, pocket gophers, bear, mountain beaver, and other small rodents. In western Washington, bear caused most barking problems, whereas porcupine and pocket gophers were usually responsible for this damage in the remainder of the Region.

Root gnawing and stem clipping were equally important regionally. Pocket gophers are accountable for all root gnawing and also part of the stem clipping of smaller trees. Hare, rabbits, mountain beaver, porcupine, and other small rodents like ground squirrels also clip stems and branches of seedlings. Root gnawing was unreported from western Washington and Oregon coastal forests but increased in importance southward in the Cascades and was a major cause of damage on the east side. Clipping incidence was higher on western Washington and Oregon coastal forests than on other areas and appeared to be somewhat more prevalent in Washington than in Oregon.

Trampling injures small seedlings and is generally attributable to elk and domestic livestock. Reports of trampling damage were relatively uniform throughout the Region.

Tree losses reported here are usually the result of removal by pocket gophers, although severance of seedlings at or just below ground level may be caused by several animals. Reports of tree losses were low regionwide and were received only from east-side forests.

Additional kinds of damage included flooding of trees growing in lowland areas behind beaver dams and pulling up of seedlings by elk. Only two instances of each of these were reported.

SEASON OF DAMAGE

Damage while conifers were dormant exceeded that occurring during the growing season in all subregions except western Washington where growing season problems were more prevalent. Many areas sustained damage during both dormant and growing seasons.

SITE CLASS FOR DOMINANT SPECIES

Regionally, problem areas were located mostly on lands classed as sites III and IV. However, as expected, site classes were generally higher on west-side forests. More than two-thirds of west-side problem areas were reported as site III or better, whereas only one-quarter of those on the east side met this criterion. Oregon coast and west-central Cascade forests contained problem areas on highest site lands.

DEFORESTATION

The majority of all problem areas had been deforested less than 10 years with the greatest number included in the 6- to 10-year category. Results from east- and west-side forests were similar except that more areas had been deforested longer than 15 years on east-side forests. Among geographic subregions, the southern Cascades reported fewer areas deforested less than 5 years.

More than three-quarters of all problem areas were clearcut. Wildfire accounted for 15 percent and partially cut or thinned areas made up 6 percent of all reports. Over 90 percent of west-side, but less than half of east-side problem areas were clearcut. Burning was five times more frequent as the cause of deforestation on east-side compared with west-side forests where wildfire was only an incidental cause, except on western Washington forests.

Slash was burned on 95 percent of all logged problem areas.

REFORESTATION

Planting was used to reforest most problem areas. Only 6 percent of the returns reported successful regeneration from natural seed fall. Eight percent of the areas were seeded, but nearly all of these were subsequently planted or interplanted. Results were similar on east- and west-side forests. Replanting or interplanting or both was required on nearly 30 percent of the areas. The greatest amount of replanting has been necessary on Oregon coast forests and the least in western Washington and on the east side.

Douglas-fir was the leader among the many species planted on problem areas. Ponderosa pine was second, followed by true firs and other pine species. Douglas-fir was planted on almost 90 percent of west-side areas with the proportion nearing 100 percent on western Washington, west-central Cascade, and Oregon coastal forests. Ponderosa pine was planted more frequently in the southern Cascades and on east-side forests.

Many areas have been planted and replanted with several species in an effort to overcome adverse site conditions, including animals.

PROBLEM ANIMALS^{2/}

The following animals were reported to be damaging trees:

Deer	<i>Odocoileus</i> spp.
Porcupine	<i>Erethizon dorsatum</i>
Gophers	<i>Thomomys</i> spp.
Snowshoe hare	<i>Lepus americanus</i>
Black-tailed jackrabbit	<i>Lepus californicus</i>
Rabbits	<i>Sylvilagus</i> spp.
Elk	<i>Cervus canadensis</i>
Cattle	<i>Bos</i> sp.
Domestic sheep	<i>Ovis</i> sp.
Domestic goats	<i>Capra</i> sp.
Horses	<i>Equus</i> sp.
Mountain beaver	<i>Aplodontia rufa</i>
Bear	<i>Euarctos americanus</i>
Voles	<i>Microtus</i> spp.
Beaver	<i>Castor canadensis</i>
Chipmunks	<i>Eutamias</i> spp.
Ground squirrels	<i>Citellus</i> spp.
Western gray squirrel	<i>Sciurus griseus</i>
Wood rats	<i>Neotoma</i> spp.

Many animals were listed only once but, nevertheless, the length of the list illustrates the complexity of the animal damage problem. Results presented in table 2 give a good indication of the relative distribution of major injurious animals and a general picture of areas where particular species are causing or are likely to cause problems.

Thirty-five percent of all returns listed two or more animals causing problems on the same area. Further analysis disclosed the following distribution of multiple animal problems: two animals, 26 percent; three animals, 6 percent; four animals, 2 percent; and six animals, 1 percent of the total number of replies.

^{2/}

Common and scientific names are those used by Ingles, L. G. *Mammals of the Pacific States*. Stanford Univ. Press. Stanford, Calif. 506 pp. 1965.

Deer

Based on numbers of replies, deer were the most troublesome animals on National Forests in the Pacific Northwest (table 2). Deer problems were consistently high throughout the region and were approached in frequency of reports only by porcupine in the southern Cascades and gophers on east-side forests. Deer problems were particularly important in the west-central Cascades and coastal forests in Oregon.

Deer browsed trees during both dormant and growing seasons (table 3). Winter use predominated on southern Cascade and east-side forests, whereas browsing occurred more often during the growing season in western Washington and coastal Oregon. Browsing during both seasons was prevalent in the west-central Cascades.

Twenty-two percent of the deer problem areas were classified as site I or II. All were on west-side forests. Forty percent were site III; 31 percent, site IV; and the remainder, site V. Nearly three-fourths of the west-side units were site III or better, whereas the same proportion of east-side units were site IV or poorer.

Regionally, about one-third of the deer problem areas had been deforested from 1 to 5 years, 44 percent from 6 to 10 years, and 25 percent longer than 10 years. Over 80 percent of the west-side and half of the east-side areas were deforested from 3 to 10 years. More than 80 percent of the deer problem areas were clearcut; 5 percent, partially cut; and the remaining 13 percent, burned by wildfire. Virtually all west-side but only one-third of the east-side areas had been clearcut. However, 46 percent of the east-side areas were on burns, and these combined with the clearcut areas totaled 81 percent of all east-side areas that were essentially nontimbered.

Table 2.--Geographic distribution of replies by problem animals reported

Area	Deer	Porcupines	Gophers	Hare and rabbits	Elk	Livestock	Small rodents	Mountain beaver	Bear
----- Percent -----									
West side:									
Western Washington	55	12	0	17	17	0	3	11	17
West-central Cascades	69	17	8	8	6	0	1	2	2
Southern Cascades	39	38	28	7	9	20	3	6	0
Oregon coast	88	1	0	27	24	21	6	16	0
Weighted average	61	17	9	14	13	9	3	9	5
East side	46	25	43	14	12	17	13	1	1
Region:									
Washington	50	15	7	15	15	4	5	9	14
Oregon	59	21	23	14	12	14	6	5	1
Weighted average	57	19	19	14	13	11	6	6	4

Table 3.--Replies to selected questions classified according to animals reported

Category	Deer	Porcupines	Gophers	Hare and rabbits	Elk	Livestock	Small rodents	Mountain beaver	Bear
----- Percent ^{1/} -----									
Season of damage:									
Dormant	61	82	78	82	64	0	74	83	19
Growing	67	38	42	38	38	100	26	27	91
Site classes:									
I	3	0	0	5	4	5	3	3	0
II	19	10	3	18	10	18	10	39	0
III	40	41	25	39	54	22	24	42	50
IV	30	39	65	31	25	40	50	16	27
V	8	10	7	7	7	15	13	0	23
Years deforested:									
1-5	31	8	17	19	35	34	15	9	0
6-10	44	26	46	38	48	33	35	17	0
11-15	14	31	16	19	13	22	26	21	0
16-25	4	20	8	7	4	2	6	3	25
26-50	7	14	10	16	0	7	18	50	63
50+	0	1	3	1	0	2	0	0	12
Deforestation cause:									
Clearcut	82	72	75	71	78	74	60	88	47
Partial cut	5	9	6	4	12	7	14	0	6
Wildfire	13	19	19	25	10	19	26	12	47
Reforestation methods:									
Natural seeding	2	13	0	5	1	0	5	6	33
Artificial seeding	11	7	9	7	13	15	18	9	6
Planting	98	87	99	95	97	99	92	94	61
Replanting or interplanting	34	31	45	43	37	43	37	53	0
Species planted:									
Douglas-fir	75	39	26	65	71	59	23	94	100
Ponderosa pine	31	71	87	41	32	59	80	12	0
Others	11	10	27	15	11	14	11	15	0

^{1/} Percentages are of replies reporting the particular category.

Ninety-eight percent of all deer problem areas were planted at least once, and 34 percent of the total were replanted or interplanted. Eleven percent were seeded, but nearly all of these were subsequently planted or interplanted. Only 2 percent of the units were successfully restocked by natural seed fall. Replanting or interplanting was required more often on Oregon than on Washington forests.

Douglas-fir was planted on three-fourths of all deer problem areas, ponderosa pine on 31 percent, true firs on 5 percent, and other species on 6 percent of the planted areas (table 3). Ninety-six percent of west-side and 9 percent of east-side units were planted with Douglas-fir. Ninety-four percent of east-side and 11 percent of west-side areas were planted with ponderosa pine.

Porcupines

Regionally, porcupines and gophers ranked second to deer. Of the two, porcupine damage was more widespread, since reports were received from all

geographic subregions (table 2). The highest proportion of porcupine problem areas was reported from southern Cascade forests and the lowest from the Oregon coast region. A surprisingly large number of porcupine reports were received from west-side forests. It is difficult to assess the importance of porcupine problems from our survey, because damage is usually spotty over wide areas which, to some extent, nullifies evaluations on the basis of cutting units or sale areas of 100 acres or less.

Dormant season damage was reported from more than 80 percent of all porcupine problem areas while growing season injuries took place on 38 percent (table 3). Nearly 90 percent of west-side and 70 percent of east-side reports listed damage during the dormant season. On the other hand, growing season injuries occurred on 65 percent of east-side but only 25 percent of west-side areas.

About one-half of all porcupine problem areas were site III or better. Three-quarters of the west-side units were site II or III, and the same proportion was site IV or V on east-side forests.

Regionally, one-third of the replies involved areas which were deforested or thinned less than 10 years. One-half were deforested from 10 to 25 years, and the remainder had been logged or burned longer than 25 years.

Nearly three-quarters of the areas damaged by porcupines were clearcut; 9 percent, partially cut or thinned; and the remaining 19 percent were burned by wildfire. Over 90 percent of west-side and 38 percent of east-side units were clearcut. Burns deforested 46 percent of east-side but only 4 percent of west-side problem areas.

Eighty-seven percent of all porcupine problem areas were planted, and 31 percent were replanted or interplanted. Thirteen percent were restocked naturally, and 7 percent were seeded. Ponderosa pine was the species used on nearly three-fourths of the planted areas (table 3). Douglas-fir was planted on 57 percent of west-side and 6 percent of east-side forests, whereas ponderosa pine was planted on 97 percent of east-side and 57 percent of west-side problem areas.

Gophers

Intensified field observations in recent years have revealed that pocket gophers are much more injurious to conifers than previously realized. In addition, as a result of better identification techniques, we suspect that gophers are responsible for many of the injuries and losses previously attributed to porcupine.

Seasonally, gopher damage was reported on more than three-fourths of all problem areas when the conifers were dormant and on 42 percent when they were growing (table 3). Dormant season damage was similar in extent on east- and west-side forests, but growing season problems were reported more often (46 percent) on east-side than on west-side (32 percent) problem areas.

Almost 75 percent of all areas damaged by gophers were site IV or V; 25 percent, site III; and the remaining 3 percent, site II. There was little difference between east- and west-side forests.

Nearly two-thirds of the gopher problem areas had been deforested less than 10 years. No west-side units were deforested less than 5 years, half were logged or burned over from 6 to 10 years, and the remainder longer than 15 years. One-quarter of the east-side areas were cut or burned less than 5 years, nearly two-thirds had been deforested 6 to 15 years, and the remaining 14 percent longer than 15 years.

Three-quarters of the gopher problem areas were clearcut--89 percent on west-side and 69 percent on east-side forests. Nineteen percent were burns--22 percent of the east-side and 11 percent of the west-side units.

Nearly all pocket gopher problem areas were planted. None were reforested from natural seed fall. Nine percent were seeded, but virtually all of these were also planted. Results were similar regionally, except that more west-side areas have been replanted.

Ponderosa pine (87 percent) has been planted on more gopher problem areas than any other species (table 3). Douglas-fir was planted on one-quarter of the areas and other species on 27 percent. Douglas-fir (52 percent) and other species (55 percent) were planted more frequently on west-side areas but on only 15 percent of east-side plantations. A total of 13 species other than ponderosa pine and Douglas-fir have been planted. Mixed-species plantings were mostly on southern Cascade and east-side forests.

Hare and Rabbits

Hare and rabbit problems were reported from all subregions with Oregon coast forests having the highest frequency. West-central and southern Cascade forests reported the fewest areas (table 2). Incidence of problems caused by these animals was similar in Oregon and Washington and on east- and west-side forests.

More than 80 percent of the hare and rabbit problem areas sustained dormant season clipping (table 3). Thirty-eight percent received clipping while conifers were growing. Dormant season clipping was reported on 93 percent of east-side and 79 percent of west-side areas. One-quarter of west-side but only 7 percent of east-side areas had growing season problems.

Almost one-quarter of the areas were located on sites I or II, and 70 percent were sites III or IV. All site I and II units were on west-side forests, whereas 83 percent of east-side areas were sites IV or V.

Regionally, 57 percent of all areas damaged by hare and rabbits had been deforested less than 10 years, 26 percent from 11 to 25 years, and the remainder more than 25 years. On the west side, 84 percent had been logged or burned less than 15 years, whereas 54 percent of east-side areas were in this category.

Almost three-quarters of all hare and rabbit problem areas were clearcut. Eighty-seven percent of west-side but only 36 percent of east-side units were clearcut. Burns deforested 56 percent of east-side and 11 percent of west-side areas.

Five percent of the areas were reforested by natural seed fall, and 7 percent were seeded. However, 95 percent were planted or interplanted, including

all seeded units. Over 40 percent of the areas required replanting or interplanting.

Douglas-fir was planted on two-thirds, ponderosa pine on 41 percent, and other species on 15 percent of all planted sites (table 3). All east-side and 16 percent of west-side problem areas were planted with ponderosa pine. Over 90 percent of west-side but no east-side areas were planted with Douglas-fir.

Elk

Reports of elk problems closely paralleled those of hare and rabbits with Oregon coast forests having the highest proportion of returns (table 2). Fewest reports were received from the west-central Cascade subregion. East- and west-side forests reported similar percentages of elk problems.

Dormant season injuries were reported on 64 percent of all elk problem areas (table 3). Almost three-quarters of west-side and one-third of east-side areas sustained elk browsing at that time. Growing season damage was reported on two-thirds of east-side and 29 percent of west-side units.

Fifty-four percent of all elk problem areas were site III. Fourteen percent, all on west-side forests, were sites I or II. Almost 80 percent of the areas were sites III or IV on both east- and west-side forests.

All elk problem areas had been deforested less than 25 years with the majority (83 percent) in the 1- to 10-year class. Reports from east- and west-side forests were similar.

More than three-quarters of all areas were clearcut--91 percent on west-side and 37 percent on east-side forests. Forty-two percent of east-side and only 2 percent of west-side elk problem areas were partially cut. The remaining 21 percent of east-side and 7 percent of west-side areas were deforested by wild-fire.

Natural regeneration was successful on only 1 percent of the elk problem areas. Thirteen percent were seeded, but 97 percent of elk problem areas were subsequently planted, and 37 percent of these were replanted or interplanted.

Douglas-fir was planted on nearly three-quarters of elk problem areas--94 percent of west-side and 10 percent of east-side units. All east-side and 6 percent of west-side areas were planted with ponderosa pine. Other species were planted on 11 percent of the units on both sides of the Cascades.

Livestock

Livestock problems were reported only from Oregon and eastern Washington forests, and, interestingly, reports from the Oregon coast forests were more frequent than those from the east-side "cow country" (table 2). Regionally, east-side forests had about twice the proportion of livestock problem areas as west-side forests.

All livestock problems occurred during the growing season, which might be expected since legal livestock use of National Forests is usually limited to summer range permittees.

Nearly one-quarter of the areas damaged by livestock were classified site I or II. All of these were on west-side forests. Regionally, 62 percent were sites III or IV. All east-side areas were site III or poorer.

Almost 90 percent of the areas had been deforested less than 15 years with the majority (67 percent) less than 10 years. Results were similar on east- and west-side forests, except that more sites were deforested more recently on west-side forests.

Nearly three-quarters of all livestock problem areas were clearcut, 7 percent were partially cut, and 19 percent were burned by wildfire. Almost 90 percent of west-side and 56 percent of east-side areas were clearcut. One-third of east-side but only 8 percent of west-side sites were burns.

Ninety-nine percent of the areas damaged by livestock were planted, and 43 percent were replanted or interplanted. Fifteen percent were seeded, but virtually all of these required planting or interplanting. Results regionwide were similar except that 53 percent of west-side but only 15 percent of east-side areas needed replanting or interplanting.

Regionally, Douglas-fir and ponderosa pine were planted on the same percentage of livestock problem areas (table 3). However, Douglas-fir was planted on 86 percent of west-side and only 21 percent of east-side areas. On the other hand, ponderosa pine was planted on 86 percent of east-side and 36 percent of west-side areas.

Small Rodents, Mountain Beaver, Bear

Descriptive details of small rodent, mountain beaver, and bear problems and problem areas are shown in tables 2 and 3. Further interpretation of the data is not made because relatively few replies were received for these animals.

DISCUSSION

Although there was a tendency to completely dissect the mass of data that was received, the rather obvious opportunity for bias here, as in many surveys, effectively ruled out blanket interpretations. On the other hand, the widespread, consistent occurrence and magnitude of answers to certain questions did allow discussions of these facets with minimal chances for error.

Strong evidence indicates that trees in many areas are exposed to animal injuries from seedling through pole or larger size classes. During postlogging stand development on a west-side Washington clearcut, planted Douglas-firs may be subjected to injuries by small rodents, mountain beaver, snowshoe hare, deer, elk, and bear. In eastern Oregon, ponderosa pines might be damaged by jack-rabbits, gophers, deer, elk, livestock, and porcupine before reaching maturity.

On a given area, damage to the same size-class of tree by more than one animal species may greatly complicate control efforts. A good example was the often reported occurrence of injuries from big game and snowshoe hare, where poisoning to alleviate hare damage could expose the game animals to similar poisoning hazards.

Although a relatively large number of problem animals was reported, it is probably safe to suggest that nearly every animal inhabiting forest land has inherent potential for injuring conifers. The main reason all possible animal species do not appear in these results might be that field foresters have not yet detected economic losses attributable to them.

Damage to trees occurred during all seasons of the year. On a given area, the same animals can be injurious year around, or one species may cause injuries during one season, and a second or third species at other times. One species or subspecies of animal may damage trees in different seasons in different locations. Deer reportedly browsed conifers mainly during the winter on some Oregon coastal areas, in the growing season in the southern Cascades, and during both periods in the central Cascades of Oregon. Most species, whose members have limited ranges like mountain beaver, pocket gophers, and snowshoe hare, exhibited similar seasonal use patterns in all of those subregions where they caused damage.

Nearly all species except deer, livestock, and bear injured conifers primarily during the dormant season. This seems to support the generally accepted assumption that many animals feed on conifers when kinds and quantities of other plants, especially green plants, are relatively limited.

Among management practices, clearcutting was a consistent precursor of animal problems throughout the Region. Wildfire, which often produces similar environmental conditions, particularly after salvage logging, was also closely tied to animal problems. Methods to control wildfire are developing slowly, and it appears that exploration of harvesting methods other than clearcutting may hold a key to prevention of a large share of potential animal problems.

In conclusion, we believe that results of the study represent a reasonably accurate, up-to-date picture of animal damage problems on National Forests in the Pacific Northwest. Effects of damage on forest-land productivity and resulting economic losses have not been evaluated because the information needed to make these evaluations is not now available.

According to the Timber Management Division, Pacific Northwest Region, about 25 percent of all reforestation work must be redone (Harold A. Dahl, personal communication). Animal damage makes necessary much of this costly supplementary work.

The magnitude of re-treatment costs, plus additional unsurveyed mortality and productivity losses, demands that foresters make accurate assessments of animal-caused losses and, where economically necessary, use all available means for controlling problem animals. In addition, research must be accelerated to evaluate effects of observed animal injuries and to devise more effective methods for alleviating and preventing damage.

Crouch, Glenn L.

1969. Animal damage to conifers on National Forests in the Pacific Northwest Region. U.S.D.A. Forest Serv. Resource Bull. PNW-28, 13 pp., illus. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

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Headquarters for the PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION is in Portland, Oregon. The Station's mission is to provide the scientific knowledge, technology, and alternatives for management, use, and protection of forest, range, and related environments for present and future generations. The area of research encompasses Alaska, Washington, and Oregon, with some projects including California, Hawaii, the Western States, or the Nation. Project headquarters are at:

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Juneau, Alaska
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The FOREST SERVICE of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.

