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Control of dwarf mistletoe in lodgepole pine, Gallatin National Forest, Mont. Note infected uncut stand, buffer zone, and noninfected new regeneration in foreground.

abundant on subalpine fir at higher elevations. Brooms were found on grand fir at lower elevations on the Coeur d'Alene National Forest.

**Air pollution.** An intensive evaluation of injury to vegetation caused by airborne fluorides at Columbia Falls, Mont., was completed in November 1971. Abnormally high levels of fluorides were found in vegetation on more than 200,000 acres of State, private, National Park, and National Forest lands.

### CENTRAL ROCKY MOUNTAINS (R-2)<sup>3</sup>

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#### Conditions in Brief

The spruce beetle and mountain pine beetle remained the most important insect pests in

<sup>3</sup> Includes forested lands in Colorado, Kansas, Nebraska, South Dakota, and eastern Wyoming.

the Central Rocky Mountains. The spruce beetle has been very active on the Medicine Bow and Gunnison National Forests. The spruce beetle infestation decreased on the San Juan National Forest, but timber windthrown late in the year poses a new threat. The mountain pine beetle infested more than 200,000 ponderosa pine trees on the Black Hills National Forest in South Dakota and Roosevelt National Forest in Colorado and adjacent private lands. This insect also killed more than 150,000 lodgepole pine on the Medicine Bow, Routt, and Arapaho National Forests and adjacent State and Bureau of Land Management lands. Also included in this estimate are Bureau of Land Management lands in northwestern Colorado.

Defoliation by the western spruce budworm increased. The lodgepole terminal weevil caused terminal damage to sapling stands of lodgepole pine on the Routt and Roosevelt National Forests.

Dwarf mistletoe of lodgepole pine continues to be the most widespread and destructive

disease in the region. Removal of infected residual trees, which eliminates a major source of infection to the understory, was practiced on more than 1,500 acres in Colorado and Wyoming. The combination of dwarf mistletoe and comandra blister rust on lodgepole pine in some parts of the Shoshone National Forest in Wyoming may be a serious limiting factor in the management of that species. Top kill and tree mortality from the rust is common in pole and mature stands.

Shoestring root rot caused by *Armillaria mellea* is a common but not serious disease in lodgepole pine less than 25 years old in Colorado. The impact of this disease on lodgepole pine management is not known.

Canker diseases and heartrot caused considerable loss in quaking aspen stands in Colorado. Both diseases are more prevalent in stands more than 100 years old and on the poorer sites. Shorter rotations and prevention of wounds are two practices that will reduce losses from both diseases.

A Dutch elm disease control program was initiated at the Bessey Nursery of the Nebraska National Forest in central Nebraska to protect valuable shade trees until they can be replaced.

#### Status of Insects

**Spruce beetle**, *Dendroctonus rufipennis* (Kby.), caused excessive volume losses of mature and overmature spruce on three National Forests and minor outbreaks on five other National Forests. The spruce beetle outbreaks on the San Juan National Forest decreased due to a combination of cold weather, a dry summer, and aggressive woodpecker activity, in addition to logging and trap tree programs. Scattered fall windstorms on the San Juan and Rio Grande National Forests resulted in windthrown timber, thus increasing available host material.

One spruce beetle outbreak diminished on the Medicine Bow National Forest, but another outbreak killed about 15,000 trees in a mostly unroaded area. On the Gunnison National Forest, the West Elk Wilderness area and adjacent land have an outbreak (about 10,000 trees)

for which no control is planned. Trap tree and logging programs were used to suppress another outbreak on the Gunnison National Forest. A spruce beetle infestation on the Big-horn National Forest is mostly within a new timber sale area. The Rio Grande and Grand Mesa-Uncompahgre National Forests each have potential problems in timber sale areas where trees felled for 1 or more years have become infested. The removal of these trees or felling of trap trees is planned for these areas.

Overall, the region's spruce beetle infestations appear to be static to decreasing. The amount of windthrow caused by winter and spring storms will be an important factor affecting the spruce beetle situation in Region 2 during 1972.

**Mountain pine beetle**, *Dendroctonus ponderosae* Hopk., remains a serious tree killer in overstocked and stagnated second-growth and mature ponderosa pine stands. The current outbreak in the Black Hills National Forest and adjacent private, State, and other Federal lands in both South Dakota and Wyoming was first reported in 1967. Losses in 1971 in the Black Hills were estimated at 274,500 trees or 21 million board feet of lumber.

Ponderosa pine stands along the Colorado Front Range continue to support mountain pine beetle infestations from Colorado Springs to the Wyoming border. These are primarily overmature and overstocked stands growing on relatively poor sites, and losses are often associated with conditions marginal for tree growth. An estimated 30,000 currently infested trees occur along the Front Range north of Denver. This includes a portion of the Pike and Roosevelt National Forests and intermingled and adjacent State and private lands.

Mountain pine beetle increased in lodgepole pine stands near Granby, Hot Sulphur Springs, and Rand in Colorado and near Encampment, Wyo. A persistent but somewhat sluggish infestation of mountain pine beetle remains active in lodgepole and limber pine near the old townsites of South Pass City and Atlantic City, Wyo., on private, Bureau of Land Management, and Shoshone National Forest lands.

**Douglas-fir beetle**, *Dendroctonus pseudotsugae* Hopk., continues to kill Douglas-fir in scattered patches, primarily in stands on rough, rocky terrain in Colorado and Wyoming. Limited logging has been the only control action on these infestation centers.

**Western spruce budworm**, *Choristoneura occidentalis* Free., defoliation on the San Isabel National Forest increased from 32,000 acres in 1970 to 113,000 acres in 1971. Sampling during 1971 indicates that, at the most, moderate (35 to 65 percent) defoliation can be expected in 1972; therefore, no control is being considered.

**Lodgepole terminal weevil**, *Pissodes terminalis* Hopp., caused extensive damage to lodgepole pine in the Roosevelt and Routt National Forests. In a 40-acre mistletoe study plot, 35 percent of the trees showed current or previous terminal damage. These trees were at least 7 feet tall and about 38 years old. Some trees showed evidence of multiple damage.

**Other insects.** Defoliation of oak by a looper, *Lambdina* sp., continued on the White River National Forest. Terminal damage was caused by the sugar pine tortrix, *Choristoneura lambertiana* (Busck.), and the southwestern pine tip moth, *Rhyacionia neomexicana* (Dyar), on ponderosa pine, San Juan National Forest. Defoliation of cottonwood along the Arkansas River near Salida, Colo., was caused by the fall webworm, *Hyphantria cunea* (Drury). The western balsam bark beetle, *Dryocoetes confusus* Sw., killed small groups of alpine fir throughout Colorado and Wyoming. The Great Basin tent caterpillar, *Malacosoma fragile* Stretch, continued defoliation of aspen in the Rio Grande National Forest. The elm leaf beetle, *Pyrrhalta luteola* (Muller), defoliated elms in northwest Nebraska along streams and in towns. *Ips pini* (Say) and *I. calligraphus* (Germ.), which had built up in slash from Christmas tree cuttings, caused mortality in ponderosa pine in the Sand Hills area of the Nebraska National Forest. The Zimmerman pine moth, *Dioroctria zimmermani* (Grote), and the western pine tip moth, *R. bushnelli*

Busck., continue to cause extensive damage to young ponderosa pine in shelterbelts.

### Status of Diseases

The dwarf mistletoes, *Arceuthobium* spp., cause more growth loss in forest trees than any other tree disease in the region. The most prevalent species are lodgepole pine dwarf mistletoe, *A. americanum* Nutt. ex. Engelm., on lodgepole pine; western dwarf mistletoe, *A. campylopodum* Engelm., on ponderosa pine; limber pine dwarf mistletoe, *A. cyanocarpum* Coulter & Nelson, on limber pine; and Douglas-fir dwarf mistletoe, *A. douglasii* Engelm., on Douglas-fir. Dwarf mistletoe control in the form of overstory removal in 10- to 20-year-old timber sale areas in lodgepole pine was practiced on more than 1,500 acres in six National Forests in Colorado and Wyoming. In addition, about 1,300 acres of potential control area in lodgepole pine was surveyed in 1971.

Timber-producing areas are given first priority in a three-stage regional mistletoe control program that involves overstory removal, growth impact evaluation surveys, and sanitation thinning. The program is being organized by management units into multiyear mistletoe control action plans.

Data collected from 12 dwarf mistletoe surveys, including a 100 percent survey of 40 acres of 20- to 40-year-old lodgepole pine in the North Park District of the Routt National Forest, are being analyzed and evaluated. The study will be continued until a survey procedure is selected that will provide the data needed to make control decisions for thinning projects. Dr. Frank Hawksworth and Dr. Jacob L. Kovner from the Rocky Mountain Forest and Range Experiment Station are assisting in the study.

Cooperative study plots were established in 1965 by the region and the station to assess silvicultural control of dwarf mistletoe. Data collected from these plots will be included in a progress report to be issued in early 1972.

**Comandra blister rust**, *Cronartium comandrae* Pk., is a destructive and prevalent disease of lodgepole pine, particularly in northern and



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This lodgepole pine overstory is heavily infected with dwarf mistletoe; spread of infection is threatening the future of the new regeneration below (Central Rocky Mountains).

western Wyoming. The presence of the rust along with dwarf mistletoe has created a difficult management situation. The widespread damage to pole and mature stands during heavy infection years in the 1930's and 1940's is now evidenced by tree mortality, dead and dying tops, and growth loss. The disease in

many stands has prematurely killed the crop trees.

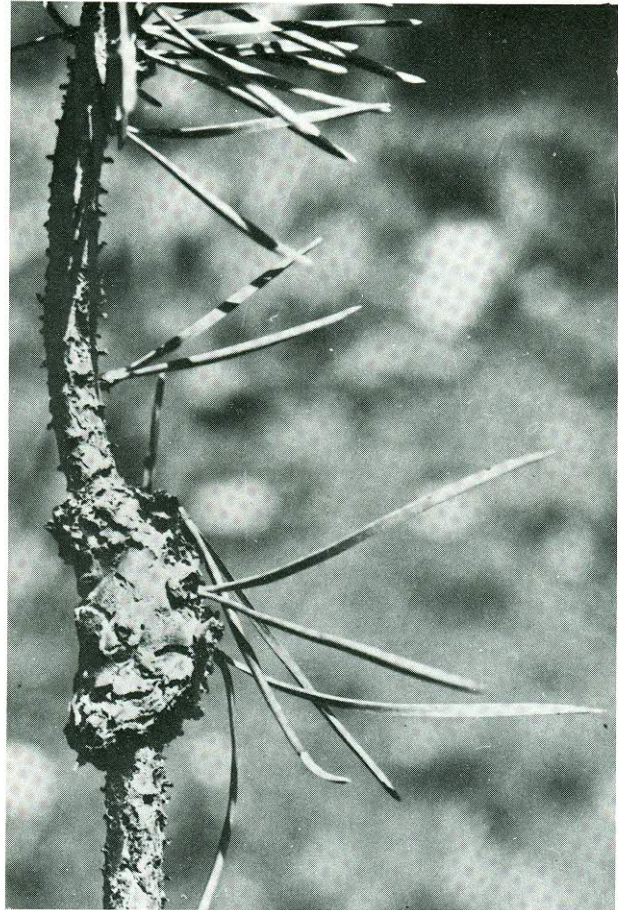
Two lodgepole pine stands, 15 to 25 years of age, in the Wind River Ranger District of the Shoshone National Forest were surveyed. Between 5 and 6 percent of the 1,200 trees examined were infected with comandra rust. The

infections were found on trees 2 to 10 years old. Additional study is needed to determine how serious the disease is to lodgepole pine management in that area. The rust, although present throughout much of the region, is most serious in the Shoshone National Forest. Occasionally the rust is found on ponderosa pine.

**Western gall rust, *Peridermium harknessii*** Moore, is present throughout much of the region with heavier than usual numbers of galls observed in some parts of the Bighorn, Roosevelt, and Black Hills National Forests. The rust is not as destructive as comandra rust because a high percentage of the infections occur as branch galls. Whenever possible, trees with stem galls are discriminated against in timber stand improvement work. In one unusual situation, ponderosa pine planted in an old burn in the Black Hills National Forest became heavily infected with the rust. The numerous galls have girdled the branches causing the trees to die. The rust is equally prevalent on ponderosa and lodgepole pine throughout the region.

**White pine blister rust, *Cronartium ribicola*** Fisch., is known to occur on pine in varying intensities in northwestern Wyoming, in the northern half of the Bighorn Mountains, and about 60 miles north of Laramie in southeastern Wyoming. The rust center discovered in the Laramie Mountains in 1969 is of more recent origin than that in the Bighorn Mountains, indicating the disease is still spreading in the Central Rocky Mountains.

**Fir and spruce broom rusts, *Melampsorella caryophyllacearum*** Schroet. and *Chrysomyxa arctostaphyli* Diet., are present in the spruce-fir type with the spruce broom rust found quite commonly in southern Colorado and the fir broom rust more commonly seen in northern Wyoming. Studies by the Intermountain and Rocky Mountain Forest and Range Experiment Stations have shown a considerable height growth loss associated with rust brooms. Additional studies have shown a considerable amount of rot associated with dead spruce tops that also have dead rust brooms. More research



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Western gall rust on lodgepole pine is found frequently in Colorado and Wyoming as well as other western States.

is needed to determine impact and intensification of broom rusts on individual trees and managed stands.

**Shoestring root rot, *Armillaria mellea*** Vahl. ex Fr. Tree killing associated with this root rot has been observed by pathologists for several years in seedling-sapling stands of lodgepole pine in Colorado. In a continuing study, the Rocky Mountain Forest and Range Experiment Station has shown a 1 to 2 percent annual mortality rate of 18- to 19-year-old lodgepole pine. Scattered tree mortality associated with *A. mellea* has been observed more recently in alpine fir and Engelmann spruce. Surveys are needed to determine distribution and impact

of this important disease in the different forest types.

**Red ring rot, *Fomes pini* (Brot. ex Fr.) Karst.** In studies conducted by Rocky Mountain Forest and Range Experiment Station personnel, cull caused by this rot involves 81 percent, 45 percent, and an estimated 20 to 30 percent of the gross board foot volume in mature and overmature Engelmann spruce, alpine fir, and lodgepole pine, respectively. Impact from heartrots can be minimized through shorter rotations. Decay studies on alpine fir show less than 2 percent volume loss in trees less than 100 years old.

**White trunk rot of aspen, *Fomes igniarius* (L. ex Fr.) Kickx.** In a recent study, approximately 75 percent of the quaking aspen examined and cut down in three campsites in the Creede Ranger District of the Rio Grande National Forest contained rot caused by *F. igniarius*. A study by the Rocky Mountain Experiment Station showed that *F. igniarius* caused the greatest volume loss of any identified decay fungus. The same study showed increasing amounts of rot occurred in aspen stands more than 100 years old and on poorer sites. Shorter rotations and prevention of wounds and scars are two practical ways that land managers can reduce losses from this disease.

**Aspen cankers.** In a survey conducted in 1960, Thomas E. Hinds, Rocky Mountain Forest and Range Experiment Station, reported the incidence of five major cankers after examining more than 4,000 quaking aspen in Colorado. The major causal organisms of aspen cankers are *Cytospora chrysosperma* Pers. ex Fr., *Cenangium singulare* (Rehm.) Davids. & Cash, *Ceratocystis* sp., and *Hypoxyylon pruina-tum* (Klotzsch.) Cke.

Cankers caused by *C. fimbriata* and *C. chrysosperma* had the highest incidence, occurring on about 5 percent of the living trees. Cankers are frequently found on trees invaded by the heartrot fungus, *F. igniarius*. The prevention of wounds, which are common entrance points for canker and decay organisms in

aspen, is strongly recommended to land managers, particularly in recreation sites.



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These sporophores (conks), growing from branch stubs, are the fruiting bodies of *Fomes igniarius*, one of the most common heartrot fungi of hardwoods in the world.

**Foliage diseases.** Foliage diseases on aspen and the different pine species are cyclic in their incidence and amount of damage observed in Colorado. Every year at least some clones of aspen affected by *Ciborinia whetzelii* Whetz. or *Marssonina populi* (Lib.) Magn. are detected during aerial detection flights. Clonal differences in susceptibility are quite striking.

Some of the more common foliage diseases on conifers in the region are *Davisomycella ponderosae* (Staley) Dark., *Hypoderma sacatum* Dark., *Dothistroma pini* Hulb., *Diplodia pinea* (Desm.) Kickx., and *Elytroderma deformans* (Weir) Dark. Natural stands of ponderosa pine at Scotts Bluff National Monument



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Aspen being girdled by the sooty-bark canker *Cenangium singulare*. Note massive canker at dead branch, upper center (Routt National Forest, Colo.).

in Nebraska have been treated until recently with fungicides to control needle cast diseases.

**Other diseases.** An outbreak of Dutch elm disease, *Ceratocystis ulmi* (Buism.) C. Mor., in central Nebraska at the Bessey Nursery, Nebraska National Forest, was evaluated last fall with formal control practices initiated in early 1971. More than 100 American elms were removed and burned last winter and the remainder pruned and sprayed with the insecticide methoxychlor. Only 30 trees of high esthetic and recreational value are now being protected. These trees, located near buildings and in a recreation area, provide the shade that is a valuable commodity during summer in the Nebraska Sand Hills. A continuing con-

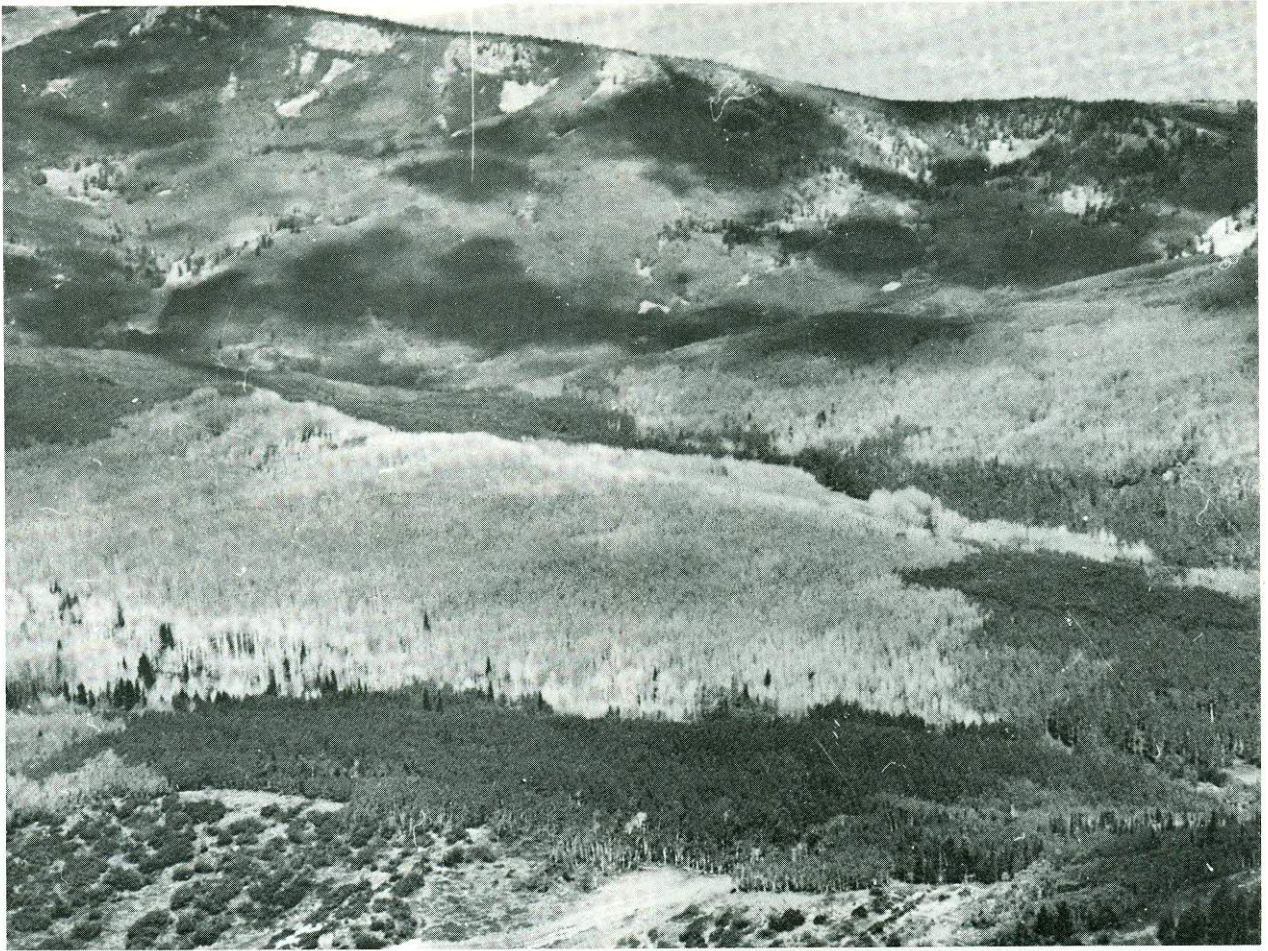
trol program will attempt to prolong the life of the remaining elms until suitable replacements are established.

A root and vascular disease, *Verticicladiella wagneri* Kend., has been receiving more attention in the West as a tree killer, particularly of pinyon pine. The disease has been observed causing extensive mortality on pinyon pine in four different locations in Colorado. Junipers growing in close proximity are not showing injury. This disease, which has been reported on ponderosa pine and Douglas-fir in California, will be given additional attention in the surveillance program of the Rocky Mountain Region.



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This slow-growing, Nectria-like canker on aspen is caused by a species of *Ceratocystis* (San Juan National Forest, Colo.).



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Light-colored aspen stand in center of this aerial view has been defoliated by the ink spot disease, *Ciborinia whatzelii* (White River National Forest, Colo.).

## SOUTHWESTERN STATES (R-3)<sup>4</sup>

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### Conditions in Brief

Record low winter temperatures, a spring drought, and gale-force winds significantly affected the insect situation in 1971 in the Southwest. Spruce beetle populations, hard hit

<sup>4</sup>Includes all forested lands in Arizona and New Mexico and National Park Service land in southern Colorado and western Texas.

by  $-40^{\circ}$  F. temperatures in January, are decreasing throughout the region. The spring drought predisposed ponderosa and pinyon pine to engraver beetle attack throughout New Mexico and Arizona. High winds in October caused extensive blowdown in the ponderosa pine, mixed conifer, and spruce forests, thus creating conditions favorable for population buildup of several important bark beetle pests. The roundheaded pine beetle remained at epidemic levels on the Lincoln National Forest and Mescalero-Apache Indian Reservation, N.Mex. Spruce beetle populations were reduced to low levels. Tree killing by the Douglas-fir beetle increased on the North Rim of Grand Canyon National Park, Ariz.