

STEWARDSHIP INCENTIVES PLAN

for

DICK SHROVE

Part of the
SE1/4 SE1/4, Sec 4, T1N, R71W, S.P.M.

(2.2 Acres)

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This management plan has been prepared at my request to guide my Stewardship management activities which I voluntarily apply on my property. I believe that activities recommended in this plan are appropriate to meet my objectives and will benefit the natural resources on my property. I intend to apply the recommended practices and to maintain them for a period of at least ten years, thus helping me to be a good steward of the forest and associated resources entrusted to me on my property.

Dick Shrove

Date

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OBJECTIVES: The forestry objectives for this property are:

1. Consistent with requirements of the Stewardship Incentives Program, to improve the health and vigor of the forest and enhance its productivity,
2. Follow silvicultural principles and multiple use management, giving particular attention to production of forest products and enhancement of wildlife habitat,
3. Preserve aesthetic qualities,
4. Protect soil and water resources.

These objectives can be accomplished by:

1. Stopping the spread of dwarf-mistletoe,
2. Planting a wildlife thicket along the east property line,
3. Salvaging wood cut in Defensible Space and Dwarf-mistletoe control practices for use as firewood, and
4. Planting a windbreak/privacy screen along the north property line.

AREA: The property contains 2.2 acres, 1.0 acres of which is forested and 1.2 acres of which is occupied by a house.

PROPERTY LOCATION: The property is located on the southeast corner of Cañon View Drive and Sunshine Lane, in Boulder Heights Subdivision.

BOUNDARY MONUMENTS: The southeast corner is marked by an aluminum cap on an iron rebar. The same marks the intersection of the south and east lines with the road rights-of-way. Other property lines are the (now) county roads.

ACCESS: Access is direct by way of the two roads and a driveway off Cañon View Drive. The entire property is accessible to vehicles.

TOPOGRAPHY: The property is on the upper east side of a spur ridge from Lee Hill. Elevation ranges from about 7450 feet above sea level along the east property line to about 7500 feet above sea level in the southwest corner. Aspects are north to south-east. Slopes average about 20%.

GEOLOGY: About 1.7 billion years ago the Boulder Creek Granodiorite Formation intruded earlier formations to form the core of what later became today's Front Range. This is the bedrock throughout the property.

Northwest trending faults of pre-Cambrian age pass near the property both to the northeast and southwest, but do not cross it. These faults have occasionally been reactivated.

Lower Paleozoic rocks (Cambrian through Mississippian) are missing in this area. It is thought that these rocks once existed, but were eroded away during Early Pennsylvanian times when the Boulder area was uplifted on the northeast flank of the Ancestral Front Range uplift, one of several northwest-trending mountain ranges that comprised the late Paleozoic Ancestral Rocky Mountains. These mountains (Ouachita Orogeny) resulted from the reactivation of Precambrian structures when Africa collided with South America and the southern edge of North America.

Sediments washing off this mountain range became the Fountain Formation which was later uplifted to form the Flatirons.

By the late Paleozoic the Ancestral Front Range was eroded to a set of low hills.

In the early Cretaceous period the area began to subside and was eventually buried under almost 10,000 feet of marine sediment.

In the late Cretaceous-early Tertiary period (about 67.5 million years ago), the Laramide Orogeny uplifted a mountain range with much the same configuration as the present day Front Range. Erosion about balanced uplift so that the relief was never great, much less than at present. By the late Eocene the uplift ceased, leaving a low-profile range of hills. Most of the faulting and eastward tilting that raised the Flatirons into position occurred during the Laramide Orogeny. Mineralization of a northeast trending pre-Cambrian shear zone occurred at this time, producing the Colorado Mineral Belt, of which the Nederland Mining District is one expression.

Intrusive volcanic activity occurred to the east during the Paleocene, but apparently did not involve this property.

During the Oligocene this region was reduced to a plain, similar to eastern Colorado today with an elevation of about 3000 feet. In the Miocene, thermal uplift and east-west expansion formed the Rio Grande Rift and began the rise of the modern Front Range, which continues to rise today.

Though this property was never glaciated (The nearest glacier almost reached Ward.), during past glacial episodes its ecotype probably fluctuated between spruce/fir and ponderosa pine forest, as the climate changed. During inter-glacials, the ecotype was probably ponderosa pine/Douglas-fir, much like it is today.

SOILS: Soil type over the entire property is Juget very gravelly sandy loam. The following soil description was written by Donald C. Moreland and Ronald E. Moreland in Soil Survey of Boulder County Area, Colorado, published by the Soil Conservation Service in 1975.

Juget Soil Series

The Juget series is made up of shallow, somewhat excessively drained soils. These soils formed on mountain slopes and ridges in sandy residuum weathered from granite. Slopes are 9 to 55 percent. Elevations are 6,300 to 8,200 feet. At lower elevations the native vegetation is mainly ponderosa pine, and at higher elevations it is Engelmann spruce and Douglas-fir with an understory of grass. Annual precipitation is 18 to 24 inches. Mean annual air temperature is 43° to 46° F., and the frost-free season is about 80 to 120 days.

In a representative profile the surface layer, about 6 inches thick, is dark-gray very gravelly sandy loam. The underlying material, about 5 inches thick, is brown very gravelly loamy sand. Underlying this layer is granite. Soil reaction is slightly acid.

Juget soils have rapid permeability. Available water capacity for the profile is low. Roots can penetrate to a depth of less than 20 inches.

These soils are used mainly for grazing, although some areas with scattered trees are used for recreation, forestry and homesites. The grass cover must be maintained to help prevent erosion.

Representative profile of Juget very gravelly sandy loam, in Juget-Rock outcrop complex, 9 to 55 percent slopes, located 2,540 feet north and 650 feet east of the southwest corner of sec. 11, T. 1 N., R. 71 W.:

- A1 - 0 to 6 inches, dark-gray (10YR 4/1) very gravelly sandy loam, black (10YR 2/1) when moist; weak, very fine, granular structure; soft, very friable; 60 percent gravel and stone; slightly acid; clear, smooth boundary.
- C - 6 to 11 inches, brown (10YR 5/3) very gravelly loamy sand, dark grayish brown (10YR 4/2) when moist; massive; hard, friable; about 80 percent fine gravel; slightly acid; clear, wavy boundary.
- R - 11 inches, hard granite bedrock.

The A1 horizon ranges from 4 to 8 inches in thickness and very gravelly sandy loam to very gravelly loamy sand in texture. Depth to bedrock ranges from 10 to 20 inches. The average rock fragment content of the soil ranges from 50 to 70 percent and is dominantly fine gravel.

Juget-Rock Outcrop Complex, 9 to 55 percent slopes (JrF). - This complex is made up of about 50 percent Juget very gravelly sandy loam and about 30 percent rock outcrop. The profile of the Juget soil in this complex is the one described as representative of the Juget series.

Included with this complex in mapping are small areas of Peyton soils near drainageways and a few small areas of Allens Park soils. These included soils make up about 20 percent of each mapped area.

Runoff is rapid on this complex. The erosion hazard is high. Juget soils take in water rapidly, but they retain only limited amounts for plant use because of their shallow depth to bedrock.

None of this complex is suitable for cultivation. It is in grass and scattered trees and shrubs. In the past, it was used for grazing livestock and for forestry, but now many areas are used for homesites, recreational purposes, and wildlife habitat. (Capability unit VIIIs-1, nonirrigated; tree suitability group 2)

HISTORICAL LAND USE: Small fires have been a frequent occurrence in the area during the period of white settlement, but there have been no major conflagrations since 1853. The area was logged in the 1870s. The section containing your property was surveyed in May, 1875 by Clarence Moffat and E. H. Kellogg. The Surveyor General's map of July 24, 1875 shows a sawmill in Fourmile Canyon, about one mile south of your property. Lee Hill is shown under the name "Table Land." The area was used for low-intensity grazing from the 1870s until it became a subdivision in the 1980s.

DESIRED CONDITION: Healthy, vigorous, fully-stocked stands of trees are required by the Stewardship Incentives Program. This condition need not be achieved immediately, but progress must be made in this direction (Because you are not receiving cost-sharing money for the plan, nothing is required, except maintaining practices for which you actually receive cost-share money.).

IMPACT ON NEIGHBORS & NEARBY COMMUNITIES: The Defensible Space practice may not even be noticed by your neighbors, who will believe it to be nothing more than landscaping around the house. The dwarf-mistletoe control practice will be adjacent to the property line and can readily be seen from adjoining lots, but efforts will be made to minimize impact, so there should be no serious problems. Most people consider tree-plantings for wind-breaks and wildlife to be aesthetically desirable; although, some people don't like the looks of weed barrier. Yield of forest products from the dwarf-mistletoe practice will probably not exceed 5 cords on a one-time-only basis and will have negligible effect on local markets.

LOCAL MARKETS: There is not enough commercial sawtimber on the property to make a sale feasible. A single small-scale firewood cutter can handle the dwarf-mistletoe work; you may wish to do your own cutting so as to use the wood yourself.

WILDLIFE: Deer are common on the property. The area is frequented by a mountain lion in late winter, and the usual assortment of rabbits, squirrels, chipmunks, ground-squirrels and other birds and small animals make use of it.

Threatened and Endangered Wildlife

The U. S. Fish and Wildlife Service lists the following species for Boulder County:

American peregrine falcon, Falco peregrinus, Endangered
Bald eagle, Haliaeetus leucocephalus, Endangered
Whooping crane, Grus americana, Endangered
Eskimo curlew, Numenius borealis, Endangered
White-faced ibis, Plegadis chihi, Category 2
Mountain plover, Charadrius montanus, Category 1
Northern goshawk, Accipiter gentilis, Category 2
Black tern, Chlidonias niger, Category 2
Mexican spotted owl, Strix occidentalis lucida, Threatened
Loggerhead shrike, Lanius ludovicianus, Category 2

Boreal toad, Bufo boreas boreas, Category 2
Black-footed ferret, Mustela nigripes, Endangered
Preble's meadow jumping mouse, Zapus hudsonius preblei,
Category 2
Fringed-tailed myotis, Myotis thysanodes pahasapensis,
Category 2
North American wolverine, Gulo gulo luscus, Category 2
Swift fox, Vulpes velox, Category 2
Greenback cutthroat trout, Oncorhynchus clarki stomias,
Threatened
Plains topminnow, Fundulus sciadicus, Category 2
Rocky Mountain capshell, Acroloxus coloradensis, Category 2
Regal fritillary butterfly, Speyeria idalia, Category 2
Lost ethmiid moth, Ethmia monachella, Category 2

The following plants are also listed:

Bell's twinpod, Physaria bellii, Category 2
Larimer aletes, Aletes humilis, Category 2
Ute ladies'-tresses orchid, Spiranthes diluvialis,
Threatened
Colorado butterflyweed, Gaura neomexicana coloradensis,
Category 1
Showy prairie gentian, Eustoma graniflorum, Category 2
Pale moonwort, Botrichium pallidum, Category 2
Purple lady's slipper orchid, Cypripedium fasciculatum,
Category 2

The peregrine falcon and bald eagle have been observed in Boulder County numerous times since 1987. The white-faced ibis was observed just across the county line at Continental Pond in Weld County in the fall of 1994.

The purple lady's slipper has been observed several times since 1987.

The Mexican spotted owl occurred in Boulder County historically, but has not been seen here since the Threatened and Endangered Species Act was passed in 1973. The nearest known nest is located south of Denver in Douglas County. A detailed search of Coal Creek, Boulder and Lefthand canyons and their tributaries is planned for the summer of 1995.

The northern goshawk is favored by the many age classes of trees created by rotational cutting. As long as buffer zones are left around nests (30 acres) and cutting activities avoid the fledging area (400 acres) during the fledging season, there should be no problems. Though this bird may occur in Boulder County, I am not aware of it. No nests occur on your property.

To the best of my knowledge, the black-footed ferret is listed only because its prey (prairie-dogs) is found here. I do not know of any sightings. The ferret is a creature of the plains and would not pose a problem for most mountain projects.

The whooping crane was included on the list because it might come here during migration. Again, I am not aware of any sightings. The same applies to the Eskimo curlew.

The Ute ladies'-tresses only occurs below 7000 feet; there is no need to worry about it at higher elevations.

The black tern is a shorebird and is a concern around creeks and reservoirs, but not in the mountains, away from water.

The black-footed ferret, preble's meadow jumping mouse, fringed-tailed myotis, Colorado butterflyweed and showy prairie gentian occur only in the plains. The mountain plover, northern goshawk, Mexican spotted owl and purple lady's slipper occur only in the mountains (except for a single spotted owl sighting in Adams County).

Other listed species could occur in either mountains or plains, especially areas where forest and prairie intermix.

Wildlife Habitat Opportunities

There are a number of practices that could be implemented to enhance the property's usefulness to various species of wildlife. Several ideas are:

1. Openings created by dwarf-mistletoe control can be used by western blue birds if there is adequate nesting cover nearby. Mount nesting boxes at head height at 100-yard intervals around the perimeter of the control area. Selected trees should be at least ten inches in diameter; with trunks sheltered by foliage from other trees and no tall grass or forbs around the stump.
2. A shrub thicket consisting of 272 Woods roses, golden currants or caraganas could be planted in a tenth-acre block along the east property line to provide food and cover.

In order to meet Stewardship requirements, at least one wildlife practice and one forest products practice must be implemented. There are scores of wildlife practices; the above are intended only as suggestions. The salvage of firewood from a Defensible Space or dwarf-mistletoe practice would meet the forest products requirement. Both practices are cost-shareable.

*Note: These practices are "required" only in the sense that they must be done first. Other than that, there are no restrictions beyond technical needs and the ten-year maintain-the-practice requirement.

INVENTORY: The entire property is in the ponderosa pine/Douglas-fir/Arizona fescue ecotype.

The stand consists of 1.0 acre (2.2 acres, counting the area immediately around the house) of ponderosa pine. There are a few sawlog-sized trees, but most are pole-sized. The area has light stocking (800 board feet per acre). The pole class contains about 5 cords and 50 square feet of basal area per acre. Both classes are about the same age (110 years).

SILVICULTURAL OBJECTIVES: The objective is to utilize as many of the property's resources as possible, thereby maximizing yield. This will be accomplished using three practices:

1. A Defensible Space practice around the house will help protect it from fire by:
 - (A) thinning trees near the house so crowns do not touch; this will keep fire from spreading to the building through the tree-tops.
 - (B) pruning trees in the thinned area so fire cannot climb from the ground into the tree-tops.
 - (C) removing accumulations of debris so that radiant heat from burning debris cannot ignite the building.

Defensible Space mainly serves to provide emergency access around the building so a fire crew can defend it without endangering themselves or their equipment. The practice is eligible for up to \$750 in cost-sharing money.

Money spent on Defensible Space activities can be added to the basis of the property for capital gains treatment when the property is sold. Under current long-term capital gains, the savings will amount to an additional 28% of out-of-pocket cost.

2. Dwarf-mistletoe control. Dwarf-mistletoe is a parasitic green plant that attacks and kills coniferous trees. In this case, ponderosa pine dwarf-mistletoe, is

attacking ponderosa pines. It is extremely slow in its development and can take as long as fifty years from first attack to tree death (usually much less). A number of trees on the south edge of your property are heavily-infected and dying from it.

Treatment consists of a combination of cutting down heavily-infected trees and pruning the infections out of lightly-infected trees. Dwarf-mistletoe is so patchy in its distribution that trees dying from it may be only yards from trees that are completely free of the disease.

Dwarf-mistletoe has an incipient stage where it is present in the tree, but not putting out aerial shoots; thus, it cannot be seen. To be sure that all infections have been removed so that new seedlings won't be infected, three or four consecutive annual cleanings are needed. Each successive cleaning removes a majority of infections, so each treatment becomes easier (and cheaper) than the last one.

The Stewardship Incentives Program can currently reimburse dwarf-mistletoe work at 65% of actual cost, up to \$200 per acre for the first treatment (Per acre cost of a project completed last fall was \$308.33; work time was 20.33 hours per acre after heavily-infected trees were sold as firewood.) The second, third and fourth treatments can be cost-shared at 65% of cost, up to \$47 per acre; after that, treatments are at the owner's expense.

3. Tree planting.

- A. Tenth-acre wildlife thicket (E). Following control of dwarf-mistletoe, the open areas should be planted (A wildlife food plot could be planted sooner as species used in these plantings are immune to dwarf-mistletoe; this would fill the wildlife practice requirement.).

A food plot requires 272 seedlings, 1150 linear feet of 6-foot weed barrier and 1200 staples. The Stewardship Incentives Program can reimburse 65% of actual cost, up to \$280. You can save the labor costs by doing the work yourself and counting your labor as part of the cost.

- B. A 184-foot visual barrier along Sunshine Lane would protect the house and yard from the road and passing traffic. Costs for a 184-foot planting are summarized below:

46 bare-root caragana @ \$.39 ea.:	\$ 17.94
30 Rocky Mountain junipers @ \$0.91 ea.:	27.30
21 ponderosa pines @ \$0.91 ea.:	19.11
1.68 rolls weed barrier @ \$100.00 ea.:	168.00
520 staples @ \$43.40/1000:	<u>22.57</u>
Sub-TOTAL, Materials	\$ 255.22
Sales Tax (3%):	<u>7.67</u>
TOTAL, Materials:	\$ 263.19

Labor:	
Planting, 97 trees @ \$2.00 ea.:	\$ 194.00
Weed barrier, 1.68 rolls @ \$96.00 ea.:	<u>161.28</u>
TOTAL, Labor	\$ 355.28

GRAND TOTAL: \$ 618.47

Stewardship Incentives Cost-sharing: 200.00
 Net: \$ 418.47

- C. A visual barrier/windbreak on your neighbor's lot would help your situation. It is too small for cost-sharing. Costs are listed below:

26 bare-root caragana @ \$.39 ea.:	\$ 10.14
17 Rocky Mountain junipers @ \$0.91 ea.:	15.47
13 ponderosa pines @ \$0.91 ea.:	11.83
1.04 rolls weed barrier @ \$100.00 ea.:	104.00
320 staples @ \$43.40/1000:	<u>13.89</u>
Sub-TOTAL, Materials	\$ 155.33
Sales Tax (3%):	<u>4.66</u>
TOTAL, Materials:	\$ 159.99

Labor:	
Planting, 56 trees @ \$2.00 ea.:	\$ 112.00
Weed barrier, 1.04 rolls @ \$96.00 ea.:	<u>99.84</u>
TOTAL, Labor	\$ 211.84

GRAND TOTAL: \$ 371.83

STEWARDSHIP "REQUIREMENTS":

First, if you don't accept the government's money, you are under no obligation whatsoever. You can carry out any combination or none of the above practices, the Colorado State Forest Service

will help you do it, and there will be no commitment beyond cost of materials and CSFS service charges.

If you do accept cost-sharing money, the only practical "requirement" is the one to "maintain the practice" for ten years. This means if something should destroy the practice, you must replace it or refund the money. Even the replacement may be eligible for cost-sharing if it wasn't your fault (like a fire started by an unknown person). If you sell the property, you must convince the new owner to assume these responsibilities, or reimburse the cost-share money.

Other requirements are handled by the administrative forester or funding committee simply by withholding practice approval and/or funding. You need not worry about these rules, accept to know that if you break one, your funding request will be denied before you can get into trouble.

Whether a practice is completed in the year shown, is not important. In this case, the order is important only to the extent that dwarf-mistletoe work must be completed before susceptible tree species can be planted and the first two practices must consist of a wood products practice (Firewood salvage from dwarf-mistletoe work counts.) and a wildlife practice (The tenth-acre thicket, nesting boxes, snag trees, etc.). This plan will be accepted as a basis for cost-sharing requests through September 30, 2005 so there is no rush.

IMPLEMENTATION SCHEDULE:

- 1995: Defensible Space. This is eligible for 65% of cost, up to \$750.00. Actual costs are highly variable, but generally do not use the entire amount.
- 1996: Wildlife practice. This could be any practice listed above. I am assuming that a tenth-acre shrub thicket will be the practice chosen. Costs are covered above. The cost-sharing program can reimburse \$280.00 for this practice.
- 1997: Visual barrier/windbreak practice. Plant the windbreak along the north property line. CSFS can help with technical information and cost-sharing paperwork, etc.
- 1998: Harvest of heavily-infected trees. This is best treated as a wood sale with the "cut" trees being sold to a firewood dealer who then cuts them. Sometimes the owner makes a little money on the deal, sometimes not, but the work gets done at a very low cost. CSFS can lay out the area,

mark the trees to be cut, find a purchaser and supervise the work.


Alternatively, you may wish to do the work yourself and keep the wood for your own use.

- 1999: First dwarf-mistletoe cleaning. Trees not removed in harvest are pruned free of all visible dwarf-mistletoe infections. Practice is cost-sharable. Many people prefer to do the work themselves. It is relaxing and not hard physically.
- 2000: Second dwarf-mistletoe cleaning. Treatment is the same as the first cleaning, except there won't be as many trees to prune.
- 2001: Third dwarf-mistletoe cleaning. Same as above. If all cleanings were thorough, this should be the last one. Because infections are easy to miss, a fourth cleaning is usually conducted.
- 2002: Fourth (and last) dwarf-mistletoe cleaning.
- 2003: No activities.
- 2004: No activities.

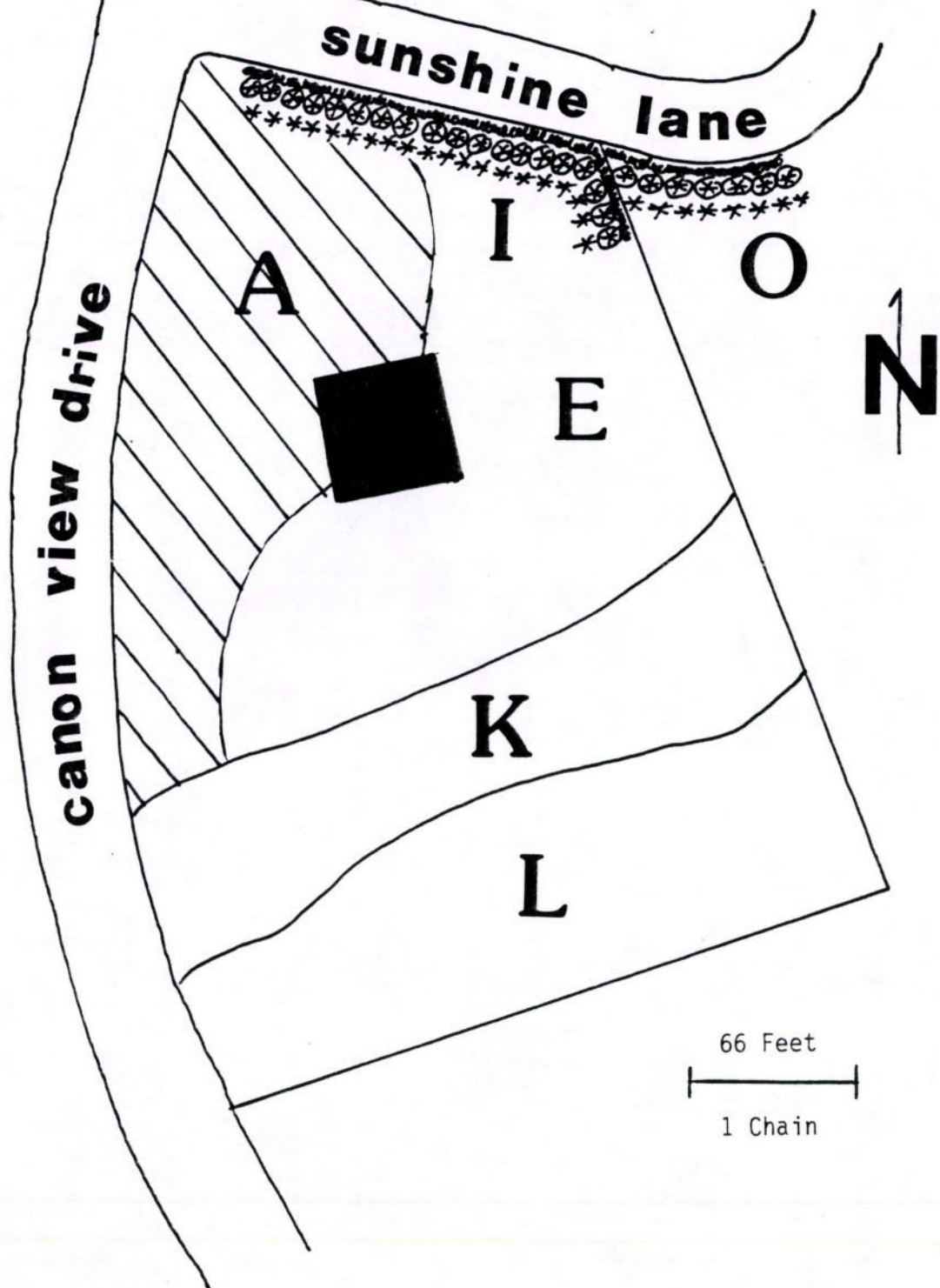
For many years to come, you can enjoy your property and at the same time, obtain a modest return on it. With people like you taking care of our forests, their well-being is assured.

Thank you.

Respectfully submitted by,


Douglas J. Stevenson

Dick Shrove



Drawn By: *Douglas Stevenson*

June 10, 1995

William M. Harlow, Ph.D., SUNY College of Forestry
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Textbook of Dendrology

DOUGLAS-FIR (Pseudotsuga menziesii (Mirb.) Franco

BOTANICAL FEATURES

Leaves $\frac{3}{4}$ " to $1\frac{1}{4}$ " long, yellow-green or blue-green, more or less flattened, standing out from all sides of the twig or with a tendency to be somewhat 2-ranked; apex rounded-obtuse or rarely acute, stomatiferous below, persistent for 8 or more years. Cones 3" to 4" long, pendent, ovoid-cylindric, with exserted, 3-lobed, forklike, appressed or strongly reflexed bracts; seeds triangular, terminally winged; about 42,000 seeds to the pound, dewinged.

Buds fusiform, sharp-pointed, lustrous brown.

Bark on young stems smooth except for resin blisters; at length becoming 6" to 24" thick on old trees, and then divided into thick reddish-brown ridges separated by deep irregular fissures. In a few instances the bark is "tight" (fine-textured) on old trees and corky on others, particularly those of the mountain form.

GENERAL DESCRIPTION

Douglas-fir, monarch of Pacific Northwest forests, was first observed by Menzies on Vancouver Island when he accompanied the British naval captain Vancouver on an expedition to the Pacific Coast in the early 1790s. For more than a quarter of a century this tree was variously classified as a spruce, hemlock, true fir, and even as a pine; in fact logs exported by the Hudson's Bay outpost near the mouth of the Columbia River were listed in European ports as "Oregon pine," a name which has persisted in the trade to this day, especially in Australia. It remained for David Douglas, a Scottish botanist sent out by the Royal Horticultural Society in 1825, to study this tree, to show that it was sufficiently different to be considered as separate from other previously described conifers; later Carrière coined the new generic name Pseudotsuga. This name was a rather unfortunate choice, since it literally means "false hemlock." The common name, Douglas-fir (The names red fir and yellow fir have been used by loggers and lumbermen to differentiate locally certain specimens on the basis of ring width, color and softness.), commemorates Douglas, and in addition serves to distinguish this species from the true fir (Abies).

Douglas-fir is a dimorphic species with two more or less distinct forms (Several European workers have claimed that there are three

species of Douglas-fir; this is based largely upon needle structure. Studies by W. E. Kilgore at the New York State College of Forestry have failed to substantiate this viewpoint.). One of these is restricted to the forests of the Pacific slope, and the other to those of the Rocky Mountain region.

The Rocky Mountain form of Douglas-fir is considered distinct from the coast form by some taxonomists, who accordingly classify it as Pseudotsuga glauca Mayr. or Pseudotsuga menziesii var. glauca (Beissn.) Franco. However, in certain sections, the two types intergrade. Usually the foliage of the Rocky Mountain tree is blue-green, but sometimes trees with blue-green foliage and others with yellow-green leaves are found standing together. Similarly, although yellow-green crowns are typical of the coast form, some trees show a blue-green coloration. The principal botanical difference between these two forms lies in the structure of their cones. Rocky Mountain trees have small cones rarely 3 inches in length, with much-exserted and strongly reflexed bracts. By contrast, the cones of the coast form are often 4 in. long and have straight, more or less appressed bracts.

Douglas-fir comprises about 50 percent of the standing timber of our western forests. It produces more timber than any other American species and at the present time furnishes about one-fifth of the total annual cut.

ROCKY MOUNTAIN FORM

The Rocky Mountain form of Douglas-fir rarely exceeds a height of more than 130 ft or a diameter of 3 ft. It occurs in both pure and mixed stands with ponderosa pine, western larch, and grand fir. Other associates include western hemlock, western white and lodgepole pines, Engelmann spruce, white fir and aspen. Douglas-fir is more tolerant than these except the hemlock and spruce.

Although most abundant on moist sites, Rocky Mountain Douglas-fir is quite drought resistant and is often found on arid areas with ponderosa pine. It is frost-resistant and hardy in the East and is a common ornamental of that region. The trees are grown for timber in Europe and have been planted successfully in many parts of the world.

RANGE

Western United States and British Columbia. Altitudinal distribution: sea level to 5,000 ft along the coast; 4,000 to 6,000 ft inland; 10,000 ft in the southern Rocky Mountains.

ENGELMANN SPRUCE (Picea engelmannii Parry)

BOTANICAL FEATURES

Leaves 1" to 1½" long, linear, 4-sided, blue-green, flexible, apex often blunt; exhaling a rank odor when crushed; often somewhat appressed and tending to point toward the tip of the twig.

Cones 1" to 2½" long, ovoid-oblong; scales thin and somewhat papery, wedgeshaped, and commonly erose at the apex; seeds ⅛" long, nearly black; wings about ½" long, oblique; about 135,000 (69,000-200,000) seeds to the pound, dewinged.

Twigs more or less pubescent, light brown to gray; bud scales more often appressed than in blue spruce.

Bark very thin, broken into large purplish brown to russet-red, thin, loosely attached scales.

GENERAL DESCRIPTION

The name of this spruce commemorates Dr. George Engelmann, noted German-American physician and botanist of the middle nineteenth century.

Engelmann spruce is typically a mountain species and under favorable conditions for growth attains a height of from 100 to 120 ft and a d.b.h. of 18 to 30 in., although somewhat larger trees (max. 165 by 6 ft) occur on the best sites. Its general habit is quite similar to that of Sitka spruce, and like that species, it reaches its maximum size on deep, rich, loamy soils of high moisture content.

Besides occurring in extensive pure stands, Engelmann spruce is found with other species comprising some 14 recognized forest types. The most common associate is subalpine fir. Through the central Rocky Mountains, lodgepole, limber, and whitebark pines, Douglas-fir and quaking aspen may also be included. Where the ranges of Engelmann and white spruce overlap, a confusing array of natural hybrids is to be found. Both Colorado blue and Sitka spruce also produce hybrids with this species.

Engelmann spruce produces large crops of seed every 3 to 6 years. Germination is particularly high (up to 97 percent) in beds of moist mineral soil, although seedling development is also good in moist duff soils covering the floor of virgin forests. A few trees are also traceable to layering, but individuals produced in this way never attain commercial proportions.

This spruce is tolerant, and among its common associates is exceeded only by subalpine fir and the hemlocks. Trees of all ages are often found under the canopy of old trees, and individuals often suppressed for 50 to 100 years quickly recover upon being

released. Growth is restricted by a short summer season; and trees 16 to 22 in. in diameter are often 350 to 450 years of age. The average maximum age for Engelmann spruce appears to be in the neighborhood of 400 years. Occasional trees over 500 years of age have been reported, and Bates (Colorado Forester, 1926) observed one stem with 660 growth rings.

Periodic outbreaks of the Engelmann spruce bark beetle have been extremely damaging to mature stands in the central Rocky Mountain region. The bark is thin even on old trunks, and fires cause extensive damage.

RANGE

Rocky Mountains, Cascade Mountains, and northeastern California. Altitudinal distribution: 1,500 to 12,000 ft in British Columbia, the Cascades, and northern Rockies; 9,000 to 11,000 ft through the central Rockies; and 10,000 to 12,000 in the southern Rockies.

LIMBER PINE (Pinus flexilis James)

DISTINGUISHING CHARACTERISTICS

Needles in 5's about 2½" long, clustered near the branch ends, dark green, stout, rigid, stomatiferous on all surfaces; resin canals dorsal. Cones 3 to 10 in. long, cylindrical, the scales thickened, and slightly reflexed at the apex; seeds large, with rudimentary wings or wingless. Bark on young stems smooth, silvery white to light gray or greenish gray; that on old trunks dark brown to nearly black, separated by deep fissures into rectangular to nearly square, superficially scaly plates or blocks.

GENERAL DESCRIPTION

Limber pine was first observed near Pike's Peak by Dr. Edwin James, an army surgeon attached to Long's Mountain Expedition of 1820. Like other relatively inaccessible trees of high altitudes, limber pine is primarily of importance in protection of valuable watersheds. Ordinarily the tree attains but small proportions, varying from 30 to 50 ft in height and from 15 to 24 in. d.b.h. (max. 85 by 7 ft). The bole is stout, noticeably tapered, and supports a number of large plumelike often drooping branches. The result is an extensive crown which not infrequently reaches to within a few feet of the ground. Young trees develop a long, sparsely branched taproot which is later supplemented by several laterals.

RANGE

East slopes of the Rocky Mountains in southern British Columbia and southern Alberta, south along the mountains to Arizona and New Mexico; west to the mountains of southern California, and north along the Sierra Nevada to northern California; east through Nevada and Idaho (one outpost is found in the Black Hills of South Dakota). Altitudinal distribution: 4,000- to 10,000-ft elevation in Montana, Wyoming, and Idaho; 4,500 to 11,500 ft in Colorado; 8,000 to 11,800 ft in southern California.

PONDEROSA PINE (Pinus ponderosa Laws.)

BOTANICAL FEATURES

Needles in 3's, or 2's on the same tree, 5" to 11" long, dark gray-green to yellow-green, flexible, persistent until the 3rd season. Crushed needles have a turpentine odor similar to that of most other pines.

Cones 3" to 6" long, ovoid to ellipsoidal, sessile, solitary or clustered; usually leaving a few basal scales attached to the twig, when shed; apophysis dark reddish brown to dull brownish yellow, transversely ridges and more or less diamond-shaped; umbo dorsal, with a slender, often deciduous prickle; seeds $\frac{1}{2}$ " long, ovoid, slightly compressed toward the apex, brownish purple; wings moderately wide, about 1" long; about 12,000 (6,900-23,000) seeds to the pound.

Twigs stout, exhaling a turpentine odor when bruised; buds usually covered with droplets of resin.

Bark brown to black and deeply furrowed on vigorous or young trees (bull pines); yellowish brown to cinnamon-red and broken into large flat, superficially scaly plates separated by deep irregular fissures on slow-growing and old trunks.

GENERAL DESCRIPTION

This is the most important pine in western North America, and in the United States is found in commercial quantities in every state west of the Great Plains. At present it furnishes more timber than any other American pine and in terms of total annual production of lumber by species is second only to Douglas-fir.

Ponderosa pine is a large tree 150 to 180 feet high and 3 to 4 ft in diameter (On the best sites, 300-year-old dominant trees average about 175 ft high and 48 in. d.b.h.) (max. 262 by 8.6 ft). Even though this species commonly forms open parklike forests, the boles are ordinarily symmetrical and clear for one-half or more of their length; short conical or flat-topped crowns are

characteristic of old trees. Four-year-old trees may have tap-roots four to five feet long. Moderately deep wide-spreading laterals develop as the trees get older. Ponderosa pine is not exacting in its soil requirements, but trees on thin, dry soils are usually dwarfed. Its occurrence on dry sites with the nut pines and certain of the junipers is indicative of its great resistance to drought. This species attains its greatest development, however, on the relatively moist but well-drained western slopes of the Siskiyou and Sierra Nevada Mountains of southern Oregon and California, respectively.

Ponderosa pine occurs in pure and mixed coniferous stands. Excellent pure forests are found in the Black Hills of South Dakota, the Blue Mountains of Oregon, the Columbian Plateau northeast of the Sierra Nevada, and in northern Arizona and New Mexico. It is also commonly the most abundant tree in mixed coniferous stands; east of the summit of the Cascade Range in Washington and Oregon it occurs with western larch, Douglas-fir, and occasionally lodgepole pine; in the central Rocky Mountains with Douglas-fir; and in California with Jeffrey and sugar pines, incense-cedar, Douglas-fir, and white fir. On the Fort Lewis plains in western Washington, near Puget Sound, ponderosa pine is occasionally found in association with Douglas-fir and Oregon white oak.

Small quantities of seed are produced annually, but large crops are released only at intervals of three to five years. Under forest conditions germination as high as 50 percent may be anticipated, but in the nursery this figure can be increased to 80 percent. Seedlings can exist under the canopy of the parent trees, even though they grow quite slowly, and in such conditions often attain a height of only 3 to 4 ft during the first 15 to 20 years. Reproduction is best in clearings made by fire or logging. The seedlings will grow on sterile sites and have been planted extensively in the Nebraska sand hills and elsewhere. Ponderosa pine is classed as intolerant.

The rapidity of growth has a marked effect on the general appearance of the trees of this species. Young, vigorous specimens commonly develop dense crowns of dark foliage, and bark which is dark brown to nearly black, more or less corky, and deeply furrowed. In contrast, the foliage of old-growth or slow-growing trees is yellow-green, and the bark yellow-brown to cinnamon-red and plated. Those of the first type are generally called "bull" or "blackjack pines," and to some woodsmen ponderosa pine and bull pine are different trees. Fast-growth bull pines 150 years of age found near Cle Elum, Washington, measured 30 to 40 in. in diameter, while more typical ponderosa pines occurring in the same vicinity were only 10 to 14 inches in diameter at the same age. The growth of this species varies considerably with locality. In California, trees 120 years of age averaged 23 in. d.b.h., while in Arizona trees of the same age were only 16 in., and in the black hills 10½ in. Trees over 500 years of age are

seldom encountered (Keen considers that this pine may reach an age of 800 years, while Mills reported a tree in southwestern Colorado with 1047 rings.). Severe damage is caused by bark beetles, and ponderosa pine is also attacked by more than 100 other kinds of insects. Fires kill seedlings and cause considerable damage even to large trees. Severe fires in the past have completely destroyed hundreds of thousands of acres of ponderosa pine forest. Other destructive agents include mistletoe and fungi.

The common name ponderosa pine is identical with the species name. Previously called western yellow pine, logs of this tree were also sold under such names as Arizona white pine, California white pine, and western soft pine, since the wood resembles that of the white pines rather than that of the hard, moderately heavy wood of the southern yellow pines. Finally, the name ponderosa pine was adopted by the U. S. Forest Service, and it is now accepted by the industry.

RANGE

Western North America. Altitudinal distribution: 5,000 to 8,000 ft in Arizona, 3,300 to 6,000 ft in Montana and South Dakota, 2,000 to 7,000 ft in northern Idaho, sea level to 6,200 ft in British Columbia and Washington, sea level (Columbia River Valley) to 7,000 ft in Oregon, 300 to 7,000 ft in northern California, 4,000 to 9,000 ft in southern California; for the most part a tree of relatively low elevations.

DWARF-MISTLETOE

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Service in Action Leaflet No. 2.925

Quick Facts

Dwarf mistletoe causes a serious forest problem in many parts of Colorado.

Hosts for mistletoe include most members of the pine family. The seeds of mistletoe are dispersed in August and early September.

The ultimate effect of dwarf mistletoe is premature death of the affected tree.

Dwarf mistletoes (Arceuthobium spp.) are a major problem in Colorado forests on ponderosa and lodgepole pine. Other members of the pine family, Douglas-fir, pinyon and limber pine are

damaged occasionally. Nursery and ornamental plantings seldom are attacked; however, this parasite can be introduced into an area by the planting of collected stock infected with dwarf mistletoe.

Dwarf mistletoes are small, leafless, parasitic flowering plants. The seeds, explosively discharged from the fruit, are very sticky and adhere to any surface they strike. Seeds that adhere to young branches of susceptible trees germinate and the mistletoe plant penetrates the bark. These seeds generally are dispersed in August and September.

This parasite is easily identified by the yellow to green or brownish-green segmented shoots that protrude from the infected part of the tree. These perennial shoots are 2 to 6 inches (5-15 centimeters) long and $\frac{1}{8}$ - to $\frac{1}{4}$ -inch (.3-.6-cm) in diameter.

The "roots" of the dwarf mistletoe are imbedded in the bark and phloem of the tree. The parasite produces secondary root-like structures called "sinkers" that become imbedded deeper in the wood as the twig adds its annual growth rings. These "roots" provide the parasite with nutrients obtained from the living tissues of its host.

Symptoms

The first symptom of dwarf mistletoe infection is a slight swelling of the bark at the site of infection. As the "roots" of the parasite become more extensive in the host, a distorted branching habit or witches' broom may form. The witches' broom diverts food from uninfected parts of the tree, subsequently reducing vigor and causing premature death of the tree. Infected trees that do not develop witches' brooms usually have visible mistletoe shoots protruding from the infected area; however, shoots are not formed until two to three years after infection.

Control

Pruning is the best control measure available for reducing or eliminating dwarf mistletoe infections in ornamental trees or urban forests. Trees severely infected in the upper branches or those with only a few live branches should be cut. Trees with high, unreachable mistletoe infections will continue to rain seeds on nearby trees if not cut down.

Lightly infected trees can be freed from the parasite by pruning off all infected branches. All branches to be pruned should be cut off flush with the trunk. The entire branch should be removed. The trees should be examined every two or three years and any infected branches pruned off. The mistletoe shoots die

as soon as the branch is cut, consequently burning pruned-off branches is not necessary.

If the mistletoe on a branch is close to the trunk the infection may have already entered the trunk. Shoots will form on the trunk even if the branch is removed. When pruning infected limbs, the following guidelines should be used to insure the trunk is free from infection. Trees with infections closer than indicated should be cut down to remove a future source of infection.

Branch diameter (outside bark)	Distance of infection on branch from trunk
Under 1.0 inch (2.5 centimeters)	6 inches (15.2 cm)
1.1 - 2.0 inches (2.8 - 5.1 cm)	8 inches (20.3 cm)
2.1 - 3.0 inches (5.3 - 7.6 cm)	10 inches (25.4 cm)
3.1 - 4.0 inches (7.9 - 10.2 cm)	12 inches (30.5 cm)

In some cases a highly desirable tree with a trunk infection cannot be removed for aesthetic or other reasons. In these instances, the mistletoe shoots must be knocked off periodically as they appear to prevent further spread.

In heavily infested areas, nonsusceptible trees can be planted to replace cut trees. Ponderosa pine areas can be planted to:

Douglas-fir	Pinyon pine	White fir
Limber pine (sic)	Blue spruce	Rocky Mountain juniper

In lodgepole pine areas, the following trees can be substituted:

Engelmann spruce	Subalpine fir	Douglas-fir
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Hardwoods such as ash, birch and aspen, also can be planted in affected areas because dwarf mistletoes do not attack hardwood trees.

DWARF-MISTLETOE ADDENDUM

Douglas J. Stevenson
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Three species of dwarf-mistletoe occur in Boulder County. They are ponderosa pine dwarf-mistletoe (Arceuthobium vaginatum), lodgepole pine dwarf-mistletoe (Arceuthobium americanum) and limber pine dwarf-mistletoe (Arceuthobium cyanocarpum), each named for its primary host.

Besides its primary host, each dwarf-mistletoe species attacks the other two pine species as a secondary host (Limber pine is attacked by ponderosa pine dwarf-mistletoe as a secondary host

and should not have been listed on the Service in Action leaflet as suitable for planting on ponderosa pine sites.). Only in rare circumstances are other species of trees affected.

Dwarf-mistletoe infects and eventually kills its primary host. Secondary hosts are much more resistant to attack. There are numerous examples of secondary host trees standing in the middle of heavy dwarf-mistletoe infections without becoming infected.

Dwarf-mistletoe control is achieved in forest situations by clear-cutting the infected patch, allowing the stand to regenerate from natural seeds from adjacent stands. If the patch is a large one, the clearcut may have to be completed in several stages so that a seed source remain nearby until the stand regenerates.

In urban settings, or with ponderosa pine dwarf-mistletoe, which is large enough to see easily, it is often feasible to prune dwarf-mistletoe out of infected trees. Due to dwarf-mistletoe's incipient stage, this process must be repeated for at least three consecutive years.

Planting with susceptible tree species before the overstory stand is free of dwarf-mistletoe will result in reinfection. Seedlings are small and not usually infected during the first few years, so if control efforts are continued until all dwarf-mistletoe is gone, an extra two or three years' growth can be obtained by planting after the first year's cleaning.