

FOREST AGRICULTURE and STEWARDSHIP PLAN

For:

HARMON GULCH TREE FARM

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SW1/4, Sec 14, T1S, R71W, S.P.M.
and
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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.

Dr. George Hart

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 principles of sustained yield forestry and multiple use management, giving particular attention to production of forest products and enhancement of wildlife habitat.
3. Preserve the aesthetic qualities.
4. Protect the soil and water resources.

AREA: The property contains 35.1 acres, all of it forested. Of this, 1.0 acres will be occupied, eventually, by a house.

PROPERTY LOCATION: Harmon Gulch Tree Farm is located on the low ridge between Woods and Harmon Gulches, about one mile east Flagstaff Road and about one mile south of Kossler Lake.

BOUNDARY MONUMENTS: The General Land Office section corner 14/15/22/23, just south of the property, is marked by a brass cap. Most property corners are marked by plastic caps on iron rebars.

ACCESS: All access is by way of Bison Drive. The terrain is steep, but accessible to trucks.

TOPOGRAPHY: The property straddles the low ridge between Harmon and Woods Gulches. Elevation ranges from about 6900 feet above sea level where Harmon Creek leaves the property to about 7152 feet above sea level at a bench mark on the property line at the hilltop on Bison Drive. Aspects are mostly southeast with some southwest. Slopes average about 25%.

GEOLOGY: Precambrian rocks now about 1.8 billion years old were intruded about 1.7 billion years ago by the Boulder Creek

Granodiorite Formation. This formation is bedrock throughout the property.

North-northwest trending faults of Precambrian Age pass nearby, but do not cross the property. 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. Gravel and sediments washing off the Ancestral Front Range were deposited as the Fountain Formation which was later uplifted to form the Flatirons. By the late Paleozoic period 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.

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 reached Nederland.), during past glacial episodes its ecotype probably fluctuated between tundra and spruce/fir forest, as the climate changed. During inter-glacials, the ecotype was probably ponderosa pine/Douglas-fir, much like it is today.

SOILS: Soil maps for the western part of Boulder County have not been published; Soil Conservation Service agronomists are in the

process of doing this at this time. The following is my attempt at soil identification and may not be completely accurate.

Ferncliff soils occur in loamy mixed alluvium and on short fans and valley side slopes throughout most of the property. The available water capacity is moderate. In general, this is a good tree-growing soil.

Juget soils are shallow, excessively drained soils formed on mountain slopes and ridges in sandy residuum weathered from granite. They have low available water capacity. Depth to bedrock is only eleven inches. The southwestern end of the property is on Juget soils.

HISTORICAL LAND USE: The existing forest originated after a fire about 1760. A number of residual trees survive from this time. Fire scars indicate a fire between 1850 and 1860. The property appears to have been logged once prior to the 1880 fire. The younger class of ponderosa pines were established shortly afterward. This class of trees is heavily-infected with dwarf-mistletoe and because of its weakened condition was decimated by the mountain pine beetle epidemic of the 1970s.

Grazing has never been a major use of this property as it has been occupied by forest since settlement first occurred; although, cattle were given access and did graze it.

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.

IMPACT ON NEIGHBORS & NEARBY COMMUNITIES: The combined effects of dwarf-mistletoe and mountain pine beetles have removed most of the tree cover from the southern three-quarters of the property. Removal of a few additional trees to control dwarf-mistletoe may or may not be noticed by neighbors. As new seedlings are planted and gradually become established, this property will be the only one in the immediate vicinity to support a fully-stocked stand: visual impacts will eventually be magnificent.

Only a few cords will be removed. Though this property may one day provide enough work to heat the owner's house, this will not occur for a very long time.

LOCAL MARKETS: Sawtimber markets in Boulder and vicinity are severely limited. Firewood markets are better, but will probably not have any impact on this property, as there is not much low-grade and cull wood available to sell.

WILDLIFE: Deer are very 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 or Endangered Species: The property is located in Block C11 (Georgetown). Protected species in this block are:

1. the American peregrine falcon
2. the bald eagle
3. the interior least tern
4. the greenback cutthroat trout and
5. the Pawnee montane skipper butterfly.

For the most part, these species do not make use of the area. The tern is a shore bird and prefers large lakes; you own no trout streams; and the butterfly occurs only in Cheeseman Canyon and its tributaries and is not found on the property.

Eagles visit Boulder in winter, staying in the piedmont area with its milder weather and migrating north when weather improves. Boulder is on the extreme southern end of the eagle's summer (nesting) range. Occasionally a pair will nest in the area, but it is very unusual.

The property is within the foraging area of a known peregrine falcon nest, but there are no nesting sites on the property.

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. A meadow created by clear-cutting a dwarf-mistletoe patch can be used by western blue birds if there is adequate nesting cover nearby. In this case, nesting boxes will be needed as there are almost no useable snag trees in the area. The Division of Wildlife is cooperating with a Boulder resident, Ruth Steel, to provide needed boxes at cost. Cost-sharing money is available to help with even this small amount. The property could support six families of bluebirds.
2. Slash left over from dwarf-mistletoe work can be piled to create shelter for small animals ("bunny houses"). A few larger pieces will be needed to hold slash off the ground and

permit access, so some three-to-six-inch diameter material will be preserved during cutting. These are constructed shelter piles and not just a haphazard pile designed more to make the site look nice than to provide animal cover.

3. A shrub thicket consisting of 250 Woods roses, golden currants or caraganas could be planted in a tenth-acre block to provide food and cover.

In order to meet Stewardship requirements, at least one wildlife practice must be implemented. There are scores of such practices; the above are intended only as suggestions. The practice is cost-shareable.

INVENTORY: The entire property is in the ponderosa pine/Douglas-fir/Arizona fescue ecotype. The mix of species in different parts of the stand represents various seral stages within this type.

Stand A consists of 26.4 acres of dwarf-mistletoe-infected ponderosa pine with scattered Douglas-firs. There are almost no sawlog-sized trees and few others. 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. Dwarf-mistletoe control, followed by planting ponderosa pines will be needed to restore forest health.

Stand B consists of 5.1 acres of lightly stocked large-pole ponderosa pines in surprisingly good condition. No treatment is needed. This stand should be left alone to grow.

Stand C consists of 2.8 acres on the east side of Harmon Gulch. It consists of a medium-stocked ponderosa pine stand. It is in good condition, which is fortunate because it is inaccessible for treatment purposes.

Stand D is the 0.8-acre riparian area along Harmon Gulch. Its major woody cover is mountain alder. Harmon Creek is intermittent at this point. Dr. Hart would like to improve it for wildlife, but with Colorado's water laws, this may be a lot of trouble for not much gain.

For all practical purposes, Stands B, C and D may be considered the same stand; all three should be left alone to grow, at least into the middle of the next decade.

SILVICULTURAL OBJECTIVES: The objective is to reestablish a healthy forest in Stand A, while protecting the other sites.

This can be accomplished by:

1. Control of dwarf-mistletoe is done to keep infected trees from infecting new seedlings, killing them and wiping out efforts to bring the stand to optimum stocking. Dwarf-mistletoes are very patchy, with lethal infection levels occurring only yards from areas that are not infected at all; thus, treatment can be localized to infected patches.

In ponderosa pine this is done by a combination of removing heavily-infected trees and pruning lightly-infected ones. Ponderosa pine dwarf-mistletoe affects only members of the pine genus. All other species, such as Douglas-fir, aspen and spruce, are immune. Ponderosa pine dwarf-mistletoe is not very vigorous in attacking lodgepole and limber pines; these can often be retained in an infected patch, without incurring serious loss.

2. Tree planting. Most of the property is currently understocked, or stocked with non-productive trees. Understocked areas have a grass sod that will present problems for seedling establishment and growth by poisoning seedlings with chemicals called allelotropes and by drinking up needed water.

Seedlings currently cost \$0.91 each. Weed barrier costs \$2.00 per tree; enough staples to anchor the weed barrier cost \$0.39; and sales tax comes to \$0.10, bringing seedling and materials to \$3.40 each. Planting costs another \$2.00 and laying individual weed barrier squares adds another \$2.50, bringing the total to \$7.90 per seedling.

It is not possible to give per acre estimates until a specific area is designated. 390 seedlings per acre are needed for reforestation planting in ponderosa pine, but previously-existing trees reduce this number and, thus, per acre cost.

There are numerous ways to reduce these costs: seedlings can be purchased in bulk (saving up to \$0.14 per tree); you might do the work yourself (saving another \$4.50 per tree); you might use slash or rocks instead of staples (saving another \$0.40 per tree).

There is also the Stewardship Incentives Program which can reimburse 65% of cost up to \$410 per acre (The Stewardship payment is not subject to Federal or Colorado income taxes.). Also, unreimbursed out-of-pocket costs for reforestation work are eligible for the 10% investment tax credit and can be deducted from income

(84-month straight line amortization, six-month convention, up to \$10,000 per year).

3. The house, when finished, should be protected by a windbreak. I recommend a three-row planting, consisting of a low shrub, such as golden current; a medium shrub, such as caragana; and an evergreen tree such as white fir or ponderosa pine. The planting should be 100-150 feet from the building on the west and/or north sides. The rows should be eight feet apart. The currents should be spaced at 4-foot intervals, the caraganas at 6-foot intervals and the conifers at 8-foot intervals. After the house is built, call your forester for more information.

IMPLEMENTATION SCHEDULE:

1995:

Remove dwarf-mistletoe from the southwest corner of the property (Block 1995). This is about 3.5 acres. This is cost-sharable under the Stewardship Incentives Program (65% of cost, including your own labor, up to \$200 per acre).

If you follow up with a planting on the same site in 1996, this can be considered site preparation and be included as a tree-planting expense for tax purposes.

If you choose not to plant, costs (not including your own labor) can be held until you sell the property and added to the basis for capital gains treatment.

1996:

1. Repeat dwarf-mistletoe cleaning of southwest patch. This second cleaning operation is much easier than the first one because most dwarf-mistletoe was removed during the first cleaning. Second, third and fourth cleanings are aimed at removing dwarf-mistletoe that was in the incipient stage during earlier cleanings or was missed. The practice is cost-sharable at 65% of actual cost up to \$70 per acre.
2. Clean another area of dwarf-mistletoe (3.5 acres, Block 1996).
3. Plant windbreak around house.

1997:

1. Clean a new area of dwarf-mistletoe (Block 1997).
2. Clean dwarf-mistletoe from Block 1996 and Block 1995.
3. Replace failed seedlings in windbreak. Replacement is critical: wind blows harder through a gap than it does on the open plain. A windbreak with a hole in it can be worse than no windbreak at all.

1998:

1. Clean a new area of dwarf-mistletoe (Block 1998).
2. Clean dwarf-mistletoe from Blocks 1997, 1996 and 1995. This is the last cleaning for Block 1995; by this time, there should be no dwarf-mistletoe infections left.
3. Replace failed seedlings in windbreak. This is the last replacement planting. By this time, there should be few, if any, failed spots.

1999:

1. Clean a new area of dwarf-mistletoe (Block 1999).
2. Clean dwarf-mistletoe from Blocks 1998, 1997 and 1996.
3. Plant Block 1995. Ponderosa pines are the most-likely to survive and do well on this site.

2000:

1. Clean a new area of dwarf-mistletoe (Block 2000).
2. Clean dwarf-mistletoe from Blocks 1999, 1998 and 1997.
3. Plant Block 1996.
4. Plant replacements in Block 1995, if needed. Usually, replacements are not needed in reforestation plantings.

2001:

1. Clean a new area of dwarf-mistletoe (Block 2001).
2. Clean dwarf-mistletoe from Blocks 2000, 1999 and 1998.
3. Plant Block 1997.
4. Plant replacements in Block 1996, if needed.

2002:

1. Clean a new area of dwarf-mistletoe (Block 2002). This is the last dwarf-mistletoe patch.
2. Clean dwarf-mistletoe from Blocks 2001, 2000 and 1999.
3. Plant Block 1998.
4. Plant replacements in Block 1997, if needed.

2003:

1. Clean dwarf-mistletoe from Blocks 2002, 2001 and 2000.
2. Plant Block 1999.
3. Plant replacements in Block 1998, if needed.

2004:

1. Clean dwarf-mistletoe from Blocks 2002 and 2001.
2. Plant Block 2000.
3. Plant replacements in Block 1999, if needed.
4. Update this plan. It is unlikely that this plan will remain current for longer than a few years. Cost-sharing programs require plan updates at least once each ten years.

If the program outlined above is followed, the dwarf-mistletoe program will end in 2005. The planting program will end in 2006 or 2007 and there will be nothing to do in 2008 and 2009.

Forester's Note: Seeding is generally a much-cheaper way to restock a stand than is planting. If sufficient progress can be made in local seeding techniques, it would be advisable to seed rather than plant. Advances in planting technology may allow the area to be regenerated without increasing costs.

A second series of maintenance cutting and planting should begin in 2010. This series will be much lighter than the first because most dwarf-mistletoe will be gone; most seedlings in the affected blocks will be eight-to-ten feet tall and not old enough to need thinning. Only a few will have suffered damage and need replacement.

SUMMARY OF OBJECTIVES:

1. Eradicate dwarf-mistletoe.
2. Restock property with a ponderosa stand.
3. Keep wind away from the house.

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.

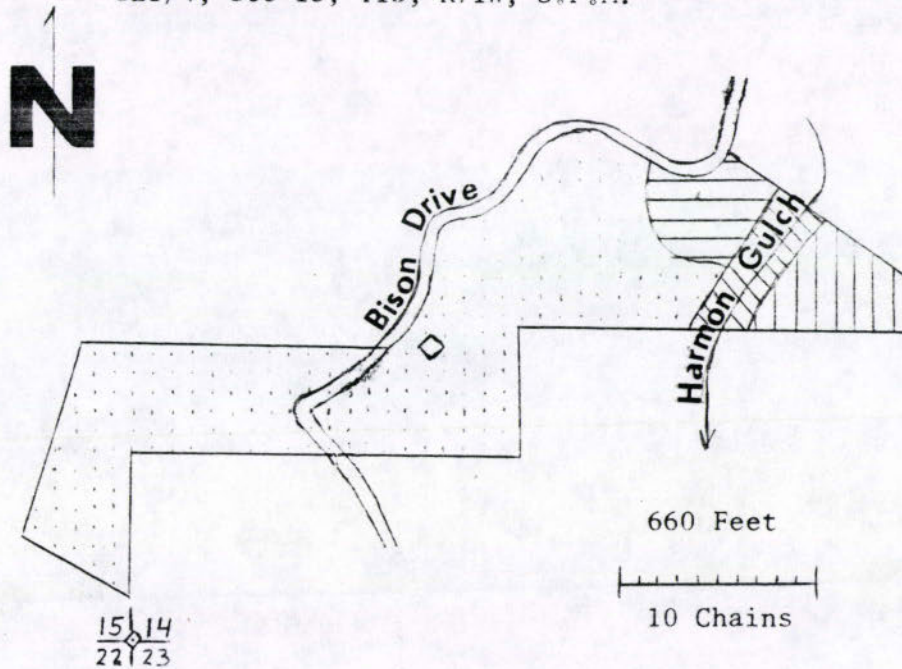
Thank you.

Respectfully submitted by,

Douglas J. Stevenson

George Hart

SW1/4, Sec 14, T1S, R71W, S.P.M.
 SE1/4, Sec 15, T1S, R71W, S.P.M.



- ◇ Section Corner
- Property Line
- == Road
- House Site
- ~> Creek
- [Dotted] Stand A (26.4 acres) Dwarf-mistletoe
- [Horizontal Lines] Stand B (5.1 acres) No treatment
- [Vertical Lines] Stand C (2.8 acres) East Side Stand
- [Diagonal Lines] Stand D (0.8 acres) Riparian

Drawn By: *Douglas Stevenson*

August 17, 1994

ALDER (Alnus B. Ehrh.)

William M. Harlow, Ph.D., SUNY College of Forestry
Ellwood S. Harrar, Ph.D., Duke University School of Forestry

Textbook of Dendrology

BOTANICAL FEATURES OF THE GENUS

Leaves mostly ovate, oval, or obovate; usually irregularly serrate or dentate.

Flowers staminate aments preformed, in racemose clusters of 3 to 5, the individual flowers consisting of 1 to 4 stamens attached to a 4-parted calyx and subtended by 3 to 5 bractlets, with 3 to 6 flowers for each scale; pistillate aments often preformed, in clusters of 2 or 3, the individual flowers composed of a naked ovary surmounted by two stigmas and subtended by 2 to 4 bractlets, in clusters of 2 to 4 at the base of bracts.

Fruit a small nutlet borne in a persistent semiwoody strobile or cone; nutlets compressed, laterally winged, chestnut-brown.

Twigs slender to moderately stout, reddish or tinged with red; buds stalked, covered by 2 or 3 valvate or imbricate scales; leaf scars raised, more or less triangular to semicircular, generally with 3 bundle scars; pith homogeneous, triangular in cross section.

MOUNTAIN ALDER (Alnus spp.)

Douglas J. Stevenson
Colorado State Forest Service

The mountain alder is more of a bush than a tree. It rarely gets more than 4" d.b.h. or more than 30 ft high. It grows in multi-stemmed clumps along flowing streams and localized wet areas in the lower mountains and foothills. It is not a commercial species and does not qualify as "forest" for purposes of the Forest Agriculture Program; although, there are usually plenty of commercial trees nearby, so the distinction is usually moot.

DOUGLAS-FIR (Pseudotsuga menziesii (Mirb.) Franco

William M. Harlow, Ph.D., SUNY College of Forestry
Ellwood S. Harrar, Ph.D., Duke University School of Forestry

Textbook of Dendrology

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.

DWARF-MISTLETOE

C. E. Swift and L. E. Dickens
Colorado State University Extension Service

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

Douglas J. Stevenson
Colorado State Forest Service

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.

PONDEROSA PINE (Pinus ponderosa Laws.)

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Textbook of Dendrology

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 $\frac{1}{4}$ " 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 taproots 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

pinus 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.