STEWARDSHIP INCENTIVES PLAN

For:

Judy Clark
296 Sandy Drive
Boulder, CO 80302

Parts of
Section 28, T1N, R71W, S.P.M.,
Section 29, T1N, R71W, S.P.M.,
Section 32, T1N, R71W, S.P.M.
and
Section 33, T1N, R71W, S.P.M.

Prepared By:

Douglas J. Stevenson
Colorado State Forest Service
936 Lefthand Canyon
Boulder, CO 80302
(303) 442-0428 (O)
(303) 448-1283 (F)

August 5, 1998

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.

_____ _____

Judy Clark Date

TABLE OF CONTENTS

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 of the property.

4. Protect the soil and water resources of the property.

AREA: The property contains 3.1 acres, all of which may be considered forested:

Forest	1.1 acres	Ponderosa pine small sawlogs, light stocking
	1.0 acres	Ponderosa pine large poles with associated Douglas-fir, medium stocking
	2.1 acres	
House	1.0 acre	
	3.1 acres	Stewardship Incentives

PROPERTY LOCATION: The property is located at the end of Sandy Drive, about 0.3 miles from Kelly Road West.

ACCESS: The property is accessible by a driveway from Sandy Drive. This is the only feasible access.

TOPOGRAPHY: The property occupies a low spur ridge on the northeast flank of the main ridge between Boulder Creek and Bummers Gulch. Elevation ranges from about 6600 feet above sea level at the south end 6700 feet on top of the ridge behind the house. Aspect is mostly south, but is north northeast on the north side of the property. South slopes are about about 25%, with north slopes up to 60%.

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

granodiorite. This formation is the bedrock throughout the property.

North-northwest trending faults of Precambrian Age pass east and west of the property. These and other similar faults in the area, have occasionally been reactivated.

Lower Paleozoic rocks (Cambrian through Mississippian) are missing in this area. It is thought 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, the Ancestral Front Range was eroded to a set of low hills.

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

In the Late Cretaceous-Early Tertiary (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 Tungsten, just below Barker Dam.), sediments eroding from it contributed to the sand and gravel deposits along Boulder Creek. Apparently, there is a connection between glacial advances and the creation of piedmont gravel fans.

SOILS: Fern Cliff Soil Series[1]

The Fern Cliff series is made up of deep, well-drained soils. These soils formed in loamy mixed alluvium on short fans and valley side slopes in the mountain area. Slopes are 15 to 60 percent. Elevations are 6,300 to 8,200 feet. The native vegetation is mainly a forest of ponderosa pine and Douglas-fir with a sparse understory of grass. Annual precipitation is 18 to 24 inches. Mean annual air temperature is 43° to 47° F., and the frost-free season is about 80 to 120 days.

In a representative profile the surface layer is dark grayish-brown stony sandy loam about 3 inches thick. The subsurface layer, about 17 inches thick, is light-gray stony sandy loam. The upper part of the subsoil, about 9 inches thick, is light-gray and yellowish-brown stony sandy loam and sandy clay loam. The sandy clay loam is in thin layers and bands in the sandy loam. The lower part of the subsoil is light brownish-gray and yellowish-brown stony sandy clay loam and sandy loam about 31 inches thick. Below this is light yellowish-brown sandy loam that contains many stones.

Fern Cliff soils have moderate to moderately rapid permeability. Available water capacity for the profile is moderate. Roots can penetrate to a depth of 60 inches or more. Moderate amounts of stone are on the surface and throughout the profile.

Reaction in the upper part of the surface layer is slightly acid, and in the subsurface layer it is medium acid. In the subsoil and substratum it is slightly acid.

These soils are used for pasture, for recreation and forestry, and for homesites.

Typical profile for Fern Cliff stony sandy loam in Fern Cliff-Allens Park-Rock outcrop complex, 15 to 60 percent slopes, located 1,400 feet south and 2,400 feet west of the northeast corner of sec.5, T. 1 N., R. 71 W.:

O1 - 4 inches to 2, undecomposed organic material, chiefly needles, bark and twigs.
O2 - 2 inches to 0, partially decomposed organic matter like that of the horizon above.
A1 - 0 to 3 inches, dark grayish-brown (10YR 4/2) stony sandy loam, very dark brown (10YR 2/2) when moist; strong, fine, crumb structure; soft, very friable; 15 to 20 percent stone; slightly acid; clear, smooth

---

[1]Moreland, Donald E. and Moreland, Ronald C., Soil Survey of Boulder County Area, Colorado, USDA - Soil Conservation Service, Denver, 1975.

boundary.

A2 - 3 to 20 inches, light-gray (10YR 7/2) sandy loam, grayish brown (10YR 5/2) when moist; weak, fine, platy structure that parts to moderate fine granular; soft, very friable; 15 to 20 percent stone; medium acid; gradual, wavy boundary.

A&B - 20 to 29 inches, light-gray (10YR 7/2) stony heavy sandy loam, grayish brown (10YR 5/2) when moist; weak, fine, subangular blocky structure; horizon contains thin, discontinuous, yellowish-brown (10YR 5/4) sandy clay loam lamellae and seams that are dark yellowish brown (10YR 4/4) when moist; in some places a soft matrix and very hard lamellae, and in other places a very friable matrix and friable lamellae; thin, nearly continuous clay films on ped faces in lamellae; 20 percent of soil horizon is stone; horizon is slightly acid; diffuse, wavy boundary.

B&A - 29 to 60 inches, yellowish-brown (10YR 5/4) stony clay loam in ½- to 2-inch thick discontinuous lamellae; these lamellae are dark yellowish brown (10YR 4/4) when moist, and interspersed between them is light brownish-gray (10YR 4/2) heavy sandy loam material like that of the horizon above; dark grayish brown (10YR 4/2) when moist; lamellae have moderate, medium, subangular blocky structure, and interspersed material is massive; lamellae are very hard and friable and interspersed material is slightly hard and very friable; lamellae have thin, continuous clay films on ped faces; this horizon is 20 percent stone; slightly acid; gradual, wavy boundary.

C - 60 to 80 inches, light yellowish-brown (2.5Y 6/3) very stony sandy loam, light olive brown (2.5Y 5/3) when moist; massive; slightly hard, very friable; 60 percent stone; slightly acid.

The A1 horizon ranges from 0 to 4 inches in thickness, and in some places it is absent. The A2 horizon ranges from loamy sand to sandy loam in texture. Content of coarse fragments ranges from 5 to 35 percent throughout the solum, but reaches as high as 60 or 70 percent in the C horizon. Depth to bedrock is 60 inches or more.

Fern Cliff-Allens Park-Rock outcrop complex, 15 to 60 percent slopes (FcF). - This complex is made up of about 30 percent Fern Cliff stony sandy loam, about 30 percent Allens Park gravelly sandy loam, and about 20 percent Rock outcrop. ....

Fern Cliff soils are on mountain slopes and short fans. Allens Park soils are on ridges and side slopes, and on saddles between the ridges. Rock outcrop is throughout the Area, but mainly on ridges.

Included with this complex in mapping are minor areas of Fern Cliff stony loamy sand, Juget soils, Peyton soils, and narrow bands of alluvial soils along drainageways. These included soils make up about 20 percent of each mapped area.

Runoff is medium to rapid on areas of this complex. The erosion hazard is high.

All of the acreage of this complex is woodland. Timber cutting is somewhat limited by the steep slope and the slow growth of trees. Some areas are used for grazing. Many areas are now used as sites for cabins and homes, and for recreational uses and wildlife habitat. (Capability unit VIIe-1, nonirrigated; tree suitability group 1).

The north end of your property has Ferncliffe soils.

Juget Soil Series[2]

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,

---

[2]Moreland, Donald E. and Moreland, Ronald C., Soil Survey of Boulder County Area, Colorado, USDA - Soil Conservation Service, Denver, 1975.

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 VIIs-1, nonirrigated; tree suitability group 2)

The south end of your property has Juget soils.

HISTORICAL LAND USE: The area was surveyed between May 10th and 19th, 1865 by Clarence Moffat and E. H. Kellogg. Sugarloaf Road (then known as Bummer's Gulch Road), Boulder Canyon Road and Magnolia Road are all shown on the Surveyor General's map of 1875. A house is shown near the place where Kelly Road West meets Sugarloaf Road. It's a pretty safe bet that this area was logged in the late 1870s for mine timbers and firewood and probably at least once since then.

A study of fire scars on this and nearby properties indicates a history of fire in this area. Fire scars indicate a fire about 1853. According to local legend, Arapahos angered at being cheated by whites, burned most of Boulder County. (A more likely explanation is that settlers were extremely careless with fire and dozens of small fires left burning would coalesce during dry weather to go rolling off as a vast sea of flame.).

DESIRED CONDITION: Healthy, vigorous, fully-stocked stands of trees are a goal of the Stewardship Incentives Program. This condition need not be achieved immediately, or even during the ten-year span of this plan, but progress should be made in this direction.

IMPACT ON NEIGHBORS & NEARBY COMMUNITIES: To the east and south you are bounded by private land; to the northwest, your property is adjacent to National Forest (That's probably the reason for all the interest in that brass cap.).

LOCAL MARKETS: You have less than three cords of firewood that could be salvaged in a dwarf-mistletoe control effort. This will be done on a one-time-only basis. Firewood and prodcut markets are largely irrelevant to your efforts.

WETLAND AREAS: There are no Federal wetlands on this property.

WILDLIFE: Though no wildlife was observed during the field exam, this typical habitat for Abert squirrels, foxes, deer, songbirds and woodpeckers.

Threatened and Endangered

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 granfiflorum, 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 has 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 in 1995 failed to turn up anything.

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 a 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.

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 and it is a shore bird and very unlikely to be seen in the mountains. The same applies to the Eskimo curlew.

The Ute ladies'-tresses only occurs below 7000 feet; there may be some on this property. It would be wise to keep an eye out for it.

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. Create woodpecker and cavity-nesting bird habitat by killing selected trees and letting them stand. As these trees die, they are attacked by woodborers and other insects which provide food for woodpeckers. As the trees decay, woodpeckers build nests in them, providing housing for themselves and other cavity-nesting birds, such as flycatchers (Woodpeckers are perfectionists; it takes them five or six tries before they get the hole just right; the extra holes are available for other animals to use.). Snags at least 10.0 inches in diameter are needed at a rate of 2.3 per acre in areas more than 300 feet from the meadows, this should be increased to at least 3.0 per acre (maximum of 7.0 snags per acre) near the meadows.

2. There is little that can be done to benefit deer on a property this small. Forest management practices encourage deer, which encourage mountain-lions, which take deer, dogs, cats, an occasional jogger and have even been known to attack children. The following practices will benefit deer, as much as is possible:

   A. When dwarf-mistletoe cuts are made, care must taken not to produce openings larger than 300 feet across, and to

leave cover strips at least 300 feet in width connecting sapling and pole stands.

B. Cutting should be done as quickly as possible to minimize animal disturbance. This restricts the choice of cutters to those capable of completing the project quickly and requires short-term cutting Agreements.

C. After all dwarf-mistletoe is removed from a portion of a stand, the cut patches should be allowed to restock themselves. If natural regeneration is not restocking the site at the end of five years, planting is recommended on the south side; the north side will retain adequate stocking, even after a dwarf-mistletoe cut.

3. Meadows (both natural and artificial) can be used by western blue birds if there is adequate nesting cover nearby. Thinning work eliminates nesting trees, unless special efforts are made to preserve useable trees. These are snags located at 100-yard intervals around the perimeter of the cut. They are created by girdling selected trees: these trees must be at least ten inches in diameter; trunks must be sheltered by foliage from other trees; and there can be no tall grass or forbs around the stump.

   It takes several years for a girdled tree to die and decay enough that woodpeckers will build nesting sites in it. In the mean-time nesting boxes should be put up. These should meet the same requirements for spacing and location as nesting trees.

4. Slash left over from dwarf-mistletoe cutting could 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 diameter material will need to 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.

In order to meet Stewardship requirements, at least one of the above practices must be implemented. Cost-sharing will probably not be available (The practices are not required if cost-sharing is not available.).

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

The Stand (2.1 acres) is a ponderosa pine stand occupying most of the property (See map.). There is not a commercial volume of sawtimber present. The northern half of the site is steep, with

access problems for anyone working on it. Dwarf-mistletoe is common with a large patch north and west of the house. Dwarf-mistletoe reduction, thinning and sale of thinning products as firewood is recommended. Total stocking runs about 1200 cubic feet per acre.

SILVICULTURAL OBJECTIVES: Free stands from dwarf-mistletoe. This should be done by dwarf-mistletoe reduction, involving cutting of heavily-infected trees, followed by three-to-five consecutive years of pruning residual trees clean. Following the fourth cleaning, stands need to be planted to bring stocking to 100 growing stock level (GSL).

The south side of the property needs no activities beyond dwarf-mistletoe control.

A Defensible Space practice around the house, in combination with dwarf-mistletoe control is recommended to enhance fire safety.

A windbreak along the west property line is recommended to keep wind from hitting the house directly.

IMPLEMENTATION SCHEDULE:

There is no minimum treatment rate.

The schedule below is suggested, not required.

1998: Remove heavily-infected dwarf-mistletoe trees from area around and west of house. Prune residual trees. Combine dwarf-mistletoe treatment with Defensible Space practice.

1999: Prune dwarf-mistletoe from area around house.

2000: Prune dwarf-mistletoe from area around house.

2001: A. Prune dwarf-mistletoe area around house.

B. Plant windbreak along west property line.

2002: A. Prune dwarf-mistletoe from area around house.

B. Re-plant failed windbreak seedlings (usually about 15%).

2003: A. Prune dwarf-mistletoe from trees around house (This should be the last pruning, if others have been thorough.).

B. Plant area west of house with ponderosa pine and white fir (Ponderosa establishes better than other trees and with the dwarf-mistletoe gone, this will be a good choice. White fir is immune to ponderosa pine dwarf-mistletoe and establishes much easier than Douglas-fir.). Note: reforestation plantings are eligible for cost-sharing, a 10% investment tax credit on unreimbursed expenses and costs can be amortized over 84 months (straight-line amortization, half-year convention) and deducted from income.

C. Revise this plan as needed. "The best-laid plans of mice and men...."

2004: Re-plant failed seedlings in reforestation area.

2005-2008: Prune dwarf-mistletoe and replant failed seedlings as needed.

SUMMARY:

With the help of cost-sharing programs, and tax benefits, this property can produce forest products profitably.

For many years to come, you can enjoy your forest. With people like you taking care of our forests, their well-being is assured.

Thank you.

Respectfully submitted by,

Douglas J. Stevenson
Assistant District Forester

BLUE SPRUCE, SILVER SPRUCE (Picea pungens var. argentea Engelm.)[3]

Those who are familiar with the shapely and beautiful silvery-blue ornamental varieties of this species would scarcely recognize the blue spruce in its central Rocky Mountain domain. Found on the middle and upper slopes, and sculptured by gale-force winds and heavy snows, the trees often bear little resemblance to the carefully nurtured specimens of park and dooryards. Even the foliage, except for a brief time in early spring when the needles are coated with a powdery waxy bloom, is dull dark green to blue-green with only an occasional tree silvery. The blue spruce often resembles the Engelmann spruce, with which it is sometimes associated at the lower elevations. Since both species may be seen as ornamentals outside their natural range, the following comparisons may be useful.

TABLE OF COMPARISON

Feature	Blue spruce	Engelmann spruce
Needles	Sharp, extending at angles to the twig; when chewed, have a sharp, acid, pungent taste	More or less blunt, usually pointing forward; lacking a sharp acid taste
Twigs	Essentially glabrous	More or less pubescent
Bud scales	Reflexed	Usually appressed
Cones	About 3" long, scales often narrow	1" to 2½" long, scales relatively broad
Form	Branch arrangement gives crown a layered appearance	Crown not layered

This species and several of its varieties, because of their habit, beautiful foliage, and ability to withstand drought and extremes of temperatures, are highly prized ornamentals in many parts of the United States.

RANGE

Yellowstone National Park near the Montana state line and northwestern Wyoming, south along the mountains to south-central New

---

[3]Harlow, William M. and Harrar, Ellwood S. Textbook of Dendrology, Fifth Edition, McGraw-Hill, New York, 1968.

Mexico; in the West, south through extreme eastern Idaho, central Utah, and central Arizona to southeastern Arizona. Altitudinal distribution: 6,000 to 9,000 ft in the North, 8,000 to 11,000 ft in the South.

DOUGLAS-FIR (Pseudotsuga menziesii (Mirb.) Franco[4]

BOTANICAL FEATURES

Leaves ¾" to 1¼" 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.),

---

[4]Harlow, William M. and Harrar, Ellwood S. Textbook of Dendrology, Fifth Edition, McGraw-Hill, 1968.

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)[5]

BOTANICAL FEATURES

Leaves 1" to 1⅜" 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.

---

[5]Harlow, William M. and Harrar, Ellwood S., Textbook of Dendrology, Fifth Edition, McGraw-Hill, New York, 1968.

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)[6]

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.

---

[6]Harlow, William M. and Harrar, Ellwood S., Textbook of Dendrology, Fifth Edition, McGraw-Hill, New York, 1968.

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.

LODGEPOLE PINE[7] (Pinus contorta Dougl.)[8]

BOTANICAL FEATURES

Needles 1" to 3" long, in 2's or rarely solitary, dark green to yellow-green, often twisted, persistent until the 4th to 6th seasons; resin canals 2, medial; epidermal cells somewhat square in cross section.

Cones ¾" to 2" long, subcylindric to ovoid, asymmetrical at the base, occasionally opening at maturity but often remaining closed for many years; apophysis tawny to dark brown, flattened, or those toward the base knoblike; umbo dorsal, terminating in a long, recurved, often deciduous prickle; seeds about 1/6" long,

---

[7]So called because of its use for poles by the Plains Indians. The lodge or tipi with its movable smoke flaps and symbolic decorations is perhaps the most functional and beautiful dwelling ever designed by nomadic man.

[8]Harlow, William M. and Harrar, Ellwood S., Textbook of Dendrology, Fifth Edition, McGraw-Hill, 1968.

ovoid, reddish brown, often mottled with black; wings ½" long; about 135,000 (111,000-165,000) seeds to the pound, dewinged.

Twigs moderately stout, dark red-brown to nearly black; buds ovoid, slightly resinous.

Bark of coastal trees ¾" to 1" thick, deeply furrowed and transversely fissured, reddish brown to black and superficially scaly; that on mountain trees about ¼" thick, orange-brown to gray, covered by thin, loosely appressed scales.

GENERAL DESCRIPTION

Lodgepole pine is a cosmopolitan tree of wide distribution through western North America. Two distinct forms of the species are recognized.

Shore pine. This is a small tree ordinarily 25 to 30 ft high and 12 to 18 in. in diameter. It is characterized by a short, often contorted bole and a dense, irregular crown of twisted branches, many of which extend nearly to the ground; the root system is deep, wide-spreading, and includes a persistent taproot, even when growing in bogs or muskegs. The tree is one of the first to invade the peat bogs of Alaska and British Columbia, as well as those of the Puget Sound basin in western Washington where it may form pure stands. Farther south it is found most abundantly on dry sandy and gravelly sites near the Pacific Ocean to northern California. Here it sometimes mingles with Sitka spruce and occasionally with grand fir. Because of their small size and poorly formed boles, the trees of the coastal form contribute little or nothing to the nation's timber supply. Large stands occasionally retard the migration of sand dunes, but smaller ones have been completely buried by shifting sands.

Lodgepole pine. This form, by contrast, is a medium-sized tree 70 to 80 ft high and 15 to 30 in. in diameter (max. 150 by 6 ft), with a long, clear, slender, cylindrical bole and short, narrow, open crown. Best development is attained on a moist but well-drained sandy or gravelly loam, although trees reach commercial proportions on a variety of soil types. Unlike the shore pine, which is seldom found far from tide water, the lodgepole pine occurs from 1,500 to 11,500 ft of elevation in either pure dense even-aged stands or in mixture with several other conifers. At the lower limits of its altitudinal range its associates are ponderosa and other western pines, Douglas-fir and western larch. At higher levels it is found chiefly with Engelmann spruce, subalpine fir, and limber pine in the Rockies; and with limber pine, Jeffrey pine, and California red fir in the Sierra.

This form is one of the most aggressive and hardy of western forest trees and under favorable conditions is capable of fully restocking cutover lands in a remarkably short time. Following fire it quickly forms dense stands and occasionally usurps areas

formerly occupied by Douglas-fir, or at higher levels by Engelmann spruce.

The gregarious habit of this species is traceable to a number of factors. The trees are prolific seeders and often produce fertile seed before they are ten years of age. Heavy seed crops occur at intervals of two or three years, but instead of releasing all of the seed at maturity, many of the cones remain closed and attached to the branches for as long as 15 to 20 or more years. When the cones remain closed, large quantities of seed are gradually accumulated. The heat of a forest fire sweeping through the stands starts the opening of the cones. After the fire has passed, the scales open fully and release their seeds upon the freshly exposed mineral soil.[9] The subsequent reproduction is often so dense that it quickly stagnates. Under normal conditions, growth is rather slow but persistent, and maturity is attained in about 200 years with a maximum of 500 to 600 years. According to Hanzlik, trees 100 years of age in the Blue Mountains of southern Oregon average 70 to 80 ft in height and 12 in. in diameter, while trees of the same age in the Sierra are 90 to 100 ft high and 15 to 18 in. in diameter. Lodgepole pine is rated as intolerant.

RANGE

Western North America. Altitudinal distribution: sea level to 2,000 ft in Alaska and British Columbia, sea level to 6,000 ft in Washington and Oregon, sea level to 11,500 ft in California, 6,000 to 11,000 ft in the Rocky Mountains.

PONDEROSA PINE (Pinus ponderosa Laws.)[10]

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.

---

[9]According to Enos Mills, a camping party once built a fire against a solitary lodgepole pine. The tree was killed, as shown by the subsequent loss of its needles. Four years later, a long tattered green pennant, formed by thousands of lodgepole pine seedlings, showed on the mountainside. This pennant, varying in width from 10 to 50 ft., began at the tree and streamed out for more than 700 ft. from its base.

[10]Harlow, William M. and Harrar, Ellwood S., Textbook of Dendrology, Fifth Edition, McGraw-Hill, 1968.

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 ¼" 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 in 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[11]

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 is 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 ⅛- to ¼-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

---

[11]Swift, C. E. and Dickens, L. E. Dwarf-Mistletoe, Colorado State University Extension Service, Service in Action Leaflet No. 2.925.

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

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[12]

Three species of dwarf-mistletoe occur in Boulder County. They are ponderosa pine dwarf-mistletoe (Arceuthobium vaginatum), lodgepole pine dwarf-mistletoe (A. americanum) and limber pine dwarf-mistletoe (A. 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.

---

[12]Stevenson, Douglas J. Dwarf-mistletoe Addendum, Colorado State Forest Service, Boulder, 1994.

VOLUME IN CORDS

(Six-inch stump height, three-inch top dob)

	Height in 4-foot bolts						
DBH	1	2	3	4	5	6	7
4	0.003	0.005	0.008	0.010	0.012	0.014	0.016
5	0.005	0.008	0.011	0.015	0.018	0.021	0.024
6	0.007	0.011	0.015	0.020	0.024	0.028	0.032
7	0.009	0.014	0.020	0.025	0.031	0.036	0.042
8	0.012	0.019	0.026	0.033	0.039	0.046	0.053
9	0.015	0.023	0.032	0.038	0.049	0.057	0.066
10	0.019	0.029	0.039	0.050	0.060	0.070	0.080
11	-----	0.035	0.047	0.060	0.072	0.084	0.096
12	-----	0.041	0.056	0.070	0.085	0.099	0.113
13	-----	0.049	0.065	0.082	0.099	0.116	0.132
14	-----	0.056	0.076	0.095	0.114	0.133	0.153
15	-----	0.064	0.086	0.108	0.130	0.152	0.174
16	-----	0.073	0.098	0.123	0.148	0.173	0.197
17	-----	0.082	0.110	0.138	0.166	0.194	0.222
18	-----	0.092	0.124	0.155	0.186	0.217	0.249
19	-----	0.103	0.138	0.172	0.207	0.242	0.277
20	-----	0.113	0.152	0.190	0.229	0.267	0.306
21	-----	-----	0.168	0.210	0.252	0.294	0.337
22	-----	-----	0.176	0.230	0.276	0.323	0.369
23	-----	-----	0.200	0.251	0.301	0.352	0.402
24	-----	-----	0.218	0.273	0.328	0.383	0.438
25	-----	-----	0.236	0.296	0.352	0.415	0.474
26	-----	-----	0.256	0.320	0.384	0.449	0.513
27	-----	-----	0.276	0.345	0.414	0.484	0.553
28	-----	-----	0.296	0.371	0.445	0.520	0.594
29	-----	-----	0.318	0.398	0.477	0.557	0.637
30	-----	-----	0.340	0.425	0.511	0.596	0.682

VOLUME IN CORDS

(Six-inch stump height, three-inch top dob)

	Height in 4-foot bolts							
DBH	8	9	10	11	12	13	14	15
4	-----	-----	-----	-----	-----	-----	-----	-----
5	0.027	0.031	0.034	-----	-----	-----	-----	-----
6	0.037	0.041	0.045	0.049	0.054	-----	-----	-----
7	0.047	0.053	0.058	0.064	0.069	0.074	0.080	0.085
8	0.060	0.067	0.074	0.081	0.087	0.094	0.101	0.108
9	0.074	0.083	0.091	0.100	0.108	0.116	0.125	0.133
10	0.091	0.101	0.111	0.121	0.132	0.142	0.152	0.162
11	0.109	0.121	0.133	0.145	0.157	0.170	0.182	0.194
12	0.128	0.142	0.156	0.171	0.185	0.200	0.214	0.228
13	0.149	0.166	0.183	0.199	0.216	0.233	0.249	0.266
14	0.172	0.191	0.210	0.230	0.249	0.268	0.287	0.307
15	0.196	0.218	0.240	0.262	0.284	0.306	0.328	0.350
16	0.222	0.247	0.272	0.297	0.322	0.347	0.372	0.400
17	0.250	0.272	0.306	0.334	0.362	0.390	0.418	0.446
18	0.280	0.311	0.343	0.374	0.405	0.437	0.468	0.499
19	0.311	0.346	0.381	0.416	0.450	0.485	0.520	0.555
20	0.344	0.382	0.421	0.459	0.498	0.536	0.575	0.613
21	0.379	0.421	0.464	0.506	0.548	0.590	0.633	0.675
22	0.415	0.462	0.508	0.554	0.601	0.647	0.693	0.740
23	0.453	0.503	0.554	0.605	0.655	0.706	0.756	0.807
24	0.493	0.548	0.603	0.658	0.713	0.768	0.823	0.878
25	0.534	0.594	0.653	0.713	0.772	0.832	0.891	0.951
26	0.578	0.642	0.706	0.771	0.835	0.899	0.964	1.028
27	0.622	0.692	0.761	0.830	0.900	0.969	1.039	1.108
28	0.669	0.743	0.818	0.892	0.967	1.041	1.116	1.190
29	0.717	0.797	0.877	0.957	1.037	1.116	1.196	1.276
30	0.767	0.852	0.938	1.023	1.109	1.194	1.279	1.365

SILVICULTURE TERMINOLOGY[13]

Advance Regeneration (Reproduction) syn
Advance Growth
Seedlings or saplings that dvelop or are present in the understory.

Afforestation
Establishment of a forest or stand in an area not previously forested.

Age Class (Cohort)
A distinct aggregation of trees originating from a single natural disturbance or regeneration cutting.

Artificial Regeneration (Reproduction)
Creation of a new age class by renewal of a tree crop by direct seeding, or by planting seedlings or cuttings.

Burning, Prescribed
The application of fire, usually under existing stands and under specific conditions of weather and fuel moisture, in order to control vegetation to meet goals of silviculture or hazard reduction.

Cleaning
A release treatment made in an age class not past the sapling stage in order to free the favored trees frpm less desirable individuals of the same age class which overtop them or are likely to do so.

Cohort
See Age Class.

Composition, Stand
The proportion of each tree species in a stand expressed as a percentage of either the total number, basal area, or volume of all tree species in the stand.

Crop Tree
Any tree that is selected to become a component of a future final harvest.

Crown
The part of a tree or woody plant bearing live branches and foliage.

Crown Class
A class of tree based on crown position relative to the crowns of adjacent trees.

Codominant
Trees with crowns forming the general level of the main canopy in even-aged groups of trees, receiving full light from above and comparatively little from the sides.

---

[13]Loftis, David L., "Silviculture Terminology" SAF Silviculture Working Group Newsletter, Society of American Foresters, Bethesda, Maryland, 1993, pp. 1-3.

Dominant
Trees with crowns extending above the general level of the main canopy of even-aged groups of trees, and receiving full light from above and partly from the sides.

Intermediate
Trees with crowns extending into the lower portion of the main canopy of even-aged groups of trees, but shorter in height than codominants. They receive little direct light from above and none from the sides.

Overtopped (Suppressed)
Trees of varying levels of vigor that have their crowns completely covered by the crowns of one or more neighboring trees.

Crown Cover
The ground area covered by the crowns of trees or woody vegetation as delimited by the vertical projection of crown perimeters and commonly expressed as a percentage of total ground area (syn. Canopy Cover).

Crown Density
The amount, compactness, or depth of foliage of the crownsof trees and/or shrubs.

Cutting Cycle
The planned interval between partial harvests in an uneven-aged stand (See Thinning Interval.).

Even-Aged Stand
A stand of trees containing a single age class in which the range of tree ages is usually less than 20% of rotation.

Harvesting Method
A cutting method by which a stand is harvested. Emphasis is on meeting logging requirements rather than silvicultural objectives (See Regeneration Methods.).

Improvement Cutting
A cutting made in a stand past the sapling stage primarily to improve composition and quality by removing less desirable tree species.

Ingrowth
Trees that during a specified period have grown past an arbitrary lower limit of (usually) diameter or height. Ingrowth is usually measured as basal area or volume per unit area.

Intermediate Treatments (Tending)
A collective term for any treatment designed to enhance growth, quality, vigor, and composition of the stand after establishment of regeneration and prior to final harvest (See Tending, Stand Improvement.).

Liberation
A release treatment made in a stand not past the sapling stage in order to free the favored trees from competition of older, overtopping trees.

Natural Regeneration
An age class created from natural seeding, sprouting, suckering, or layering.

Nurse Tree (Nurse Crop)
A tree, group or crop of trees, shrubs, or other plants, either naturally occurring or introduced, used to nurture or improve the form of a more important tree or crop during youth by protecting it from frost, insolation, or wind.

Overstory Removal
The cutting of trees comprising an upper canopy layer in order to release trees or other vegetation in an understory.

Precommercial Thinning (PCT)
A thinning that does not yield trees of commercial value, usually designed to improve crop spacing.

Regeneration (Reproduction) Method
A cutting method by which a new age class is created. The major methods are Clearcutting, Seed Tree, Shelterwood, Selection, and Coppice (See Harvesting Method.).

Even-Aged Methods

Clearcutting
A method of regenerating an even-aged stand in which a new age class develops in a fully-exposed microclimate after removal, in a single cutting, of all trees in the previous stand. Regeneration is from natural seeding, direct seeding, planted seedlings, and/or advance reproduction. Harvesting may be done in groups or patches (**Group or Patch Clearcutting**), or in strips (**Strip Clearcutting**). In the Clearcutting System, the management unit or stand in which regeneration, growth, and yield are regulated consists of the individual clearcut stand (See Group Selection).

Clearcutting with Reserves
A clearcutting method in which varying numbers of reserve trees are not harvested to attain goals other than regeneration.

Seed Tree
An even-aged regeneration method in which a new age class develops from seedlings that germinate in fully-exposed micro-environments after removal of all the previous stand except a small number of trees left to provide seed. Seed trees are removed after regeneration is established.

Seed Tree with Reserves
A seed tree method in which some or all of the seed trees are retained after regeneration has become established to attain goals other than regeneration.

Shelterwood
A method of regenerating an even-aged stand in which a new age class develops beneath the partially-shaded micro-environment provided by residual trees. The sequence of treatments can include three distinct types of cuttings: 1) an optional preparatory harvest to enhance conditions for seed production; 2) an establishment harvest to prepare the seed bed and create a new age class; and 3) a removal harvest to release established regeneration from competition with the overwood. Harvesting may be done uniformly throughout the stand (**Uniform**

Shelterwood), in groups or patches (**Group Shelterwood**), or in strips (**Strip Shelterwood**).

Shelterwood with Reserves

A variant of the Shelterwood Method in which some or all of the shelter trees are retained, well beyond the normal period of retention, to attain goals other than regeneration. The resulting stand may be two-aged or tend towards an uneven-aged condition as a consequence of both an extended period of regeneration establishment and the retention of reserve trees that may represent one or more age classes.

Two-Aged Methods

Methods designed to maintain and regenerate a stand with two age classes (See Shelterwood with Reserves and Coppice with Reserves.).

Uneven-Aged (Selection) Methods

Methods of regenerating a forest stand, and maintaining an uneven-aged structure, by removing some trees in all size classes either singly, in small groups, or in strips.

Group Selection

A method of regenrating uneven-aged stands in which trees are removed, and new age classes are established, in small groups. The maximum width of groups is approximately twice the height of the mature trees, with small openings providing micro-environments suitable for tolerant regeneration and the larger openings providing conditions suitable for more intolerant regeneration. In the Group Selection system, the management unit or stand in which regeneration, growth, and yield are rewgulated consists of a landscape containing an aggregation of groups (See Clearcutting.).

Single Tree Selection

A method of creating new age classes in uneven-aged stands in which individual trees of all size classes are removed more-or-less uniformly throughout the stand to achieve desired stand structural characteristics.

Coppice Methods

Methods of regenerating a stand in which the majority of regeneration is from stump sprouts or root suckers.

Coppice

A method of regenerating a stand in which all trees in the preivious stand are harvested and the majority of regeneration is from sprouts or root suckers.

Coppice with Reserves

A coppice method in which reserve trees are retained to attain goals other than regeneration. The method normally creates a two-aged stand.

Regeneration (Reproduction) Period

The time between the initial regeneration cutting and the successful re-establishment of a new age class by natural means, planting, or direct seeding.

Regular Uneven-Aged (Balanced) Stand
A stand in which three or more distinct age classes occupy approximately equal areas and provide a balanced distribution of diameter classes.

Release (Release Operation)
A treatment designed to free young trees from undesirable, usually overtopping, competing vegetation. Treatments include cleaning, liberation, and weeding (See Stand Improvement.).

Reserve Trees
Trees pole-sized or larger, retained after the regeneration period under the Clearcutting, Seed Tree, Shelterwood, or Coppice Methods. syn. Standards.

Salvage Cutting
The removal of dead trees or trees being damaged or killed by injurious agents other than competition, to recover value that would otherwise be lost.

Sanitation Cutting
The removal of trees to improve stand health and to reduce actual or anticipated spread of insects and disease (See Stand Improvement.).

Sapling
A tree, usually young, that is larger than a seedling but smaller than a pole.

Silviculture
The art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands. Silviculture entails the manipulation of forest and woodland vegetation in stands and on landscapes to meet the diverse needs and values of landowners and society on a sustainable basis.

Silvicultural System
A planned process whereby a stand is tended, harvested, and re-established. The system name is based on the number of age classes (See Even-Aged, Two-Aged, Uneven-Aged.), and/or the regeneration method used (See Clearcutting, Seed Tree, Shelterwood, Selection, Coppice, Coppice with Standards.).

Site Class
A classification of site quality, usually expressed in terms of ranges of dominant tree height at a given age or potential mean annual increment at culmination.

Site Preparation
A hand or mechanized manipulation of a site designed to enhance the success of regeneration. Treatments may include chopping, discing, bedding, raking, burning and scarifying. All treatments are designed to modify the soil, litter, vegetation and to create microclimate conditions conducive to the establishment and growth of desired species.

Site Quality (Productivity)
The productive capacity of a site, usually expressed as volume production of a given species.

Size Classes
Tree sizes recognized by distinct ranges, usually of diameter or height.

Stand
A contiguous group of trees sufficiently uniform in age class distribution, composition, and structure, and growing on a site of sufficiently uniform quality, to be a distinguishable unit (See Mixed, Pure, Even-Aged, and Uneven-Aged Stands.).

Mixed Stand
A stand in which there is a mixture of species.

Pure Stand
A stand composed of essentially a single species.

Stratified Mixture
A stand in which different species occupy different strata of the total crown canopy.

Stand Density
A quantitative, absolute measure of tree occupancy per unit area in such terms as numbers of trees, basal area, or volume.

Stand Improvement
A term comprising all intermediate cuttings made to improve the composition, structure, condition, health and growth of even- or uneven-aged stands.

Stocking
An indication of growing-space occupancy relative to a pre-established standard. Common induces of stocking are based on percent occupancy, basal area, Relative Density, and Crown Competition Factor.

Stratum (Canopy Layer)
A distinct layer of vegetation within a forest community.

Tending
See Intermediate Treatments.

Thinning
A cutting made to reduce stand density of trees primarily to improve growth, enhance forest health, or to recover potential mortality.

Crown Thinning (Thinning From Above, High Thinning)
The removal of trees from the dominant and codominant crown classes in even-aged stands, or in even-aged groups within uneven-aged stands, in order to favor the best trees of those same crown classes.

Free Thinning
The removal of trees in enev-aged or uneven-aged stands to control stand spacing and favor desired trees using a combination of thinning criteria without regard to crown position.

Low Thinning (Thinning From Below)
The removal of trees from the lower crown classes to favor those in the upper crown classes.

Mechanical Thinning (Geometric Thinning)
The thinning of trees in either even- or uneven-aged stands involvingremoval of trees in rows, strips, or by using fixed spacing intervals.

Selection Thinning (Dominant Thinning)
The removal of trees in even-aged stands, or in even-aged groups within even-aged stands, in the dominant crown class in order to favor the lower crown classes.

Thinning Interval
The period of time between successive thinning entries, usually used in connection with even-aged stands (See Cutting Cycle.).

Tolerance, Shade
The relative capacity of a plant to become established and grow in the shade.

Two-Aged Stand
A stand composed of two distinct age classes that are separated in age by more than 20 percent of rotation.

Undercutting (Root Pruning)
The root pruning of seedlings in a nursery bed.

Uneven-Aged Stand
A stand of trees of three or more distinct age classes, either intimately mixed or in small groups.

Uneven-Aged System
A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes (See Single Tree Selection, Group Selection.).

Weeding
A release treatment in stands not past the sapling stage that eliminates or suppresses undesirable vegetation regardless of crown position.

Wrenching
The disturbance of seedling roots in a nursery bed (e.g. with a tractor-drawn blade) with the objecdtive of stimulating the development of a fibrous root system.