

Glacier Lake Property Owners Inc. From Coordinate Identification map.

STEWARDSHIP INCENTIVES PLAN

For:

Lynn Sibley
1327 Peachtree Street NE #504
Atlanta, GA 30309

Parts of
NE1/4 SE1/4, Sec 25, T1N, R73W, S.P.M.
and part of the
Pacific Millsite (M.S. 383B).

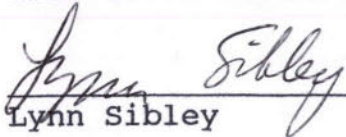
11.9 Acres

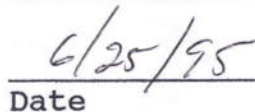
Prepared By:

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

May 24, 1995

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.


Lynn Sibley


Date

STEWARDSHIP INCENTIVES PLAN

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OBJECTIVES: The forestry objectives for this property are:

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

AREA: The property contains 11.9 acres, all of it forested; 3.1 acres is mostly open due to removal of dwarf-mistletoe trees. There is a building site designated in this open area.

PROPERTY LOCATION: The property is located on the Peak-to-Peak Highway (CO-7), about five miles north of Nederland.

BOUNDARY MONUMENTS: No boundary monuments were located during field work. Most of the property is bounded on the east and south by the old CO-7 right-of-way and a small part of the southwest side is bounded by the current CO-7 right-of-way.

ACCESS: Access is by way of Old CO-7. The entire property is accessible to vehicles, except where the dense lodgepole pine stand blocks access. Slope is not a problem for vehicles.

TOPOGRAPHY: The property is on top of a low hill southwest of Glacier Lake. Elevation ranges from about 9010 feet above sea level in the southwest corner to over 9120 feet above sea level on top of the hill. Aspects are mostly southwest, but all aspects are present. Slopes are mostly flat, but in a few places reach 30%.

GEOLOGY: Bedrock throughout the property consists of undifferentiated Precambrian metasedimentary and metavolcanic gneisses and

schists about 1.8 billion years old, by far the oldest rocks in Boulder County. These rocks formed the core of what later became today's Front Range.

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

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

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

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

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 (It had an excellent view of one to the west.), during past glacial episodes its ecotype was probably alpine tundra. During interglacials, the ecotype was probably lodgepole pine/spruce/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. From on-the-ground observations, I believe most of the property to be located on a soil very similar to Juget very gravelly sandy loam. The following soil descriptions were written by Donald C. Moreland and Ronald E. Moreland in Soil Survey of Boulder County Area, Colorado, published by the Soil Conservation Service in 1975.

Juget Soil Series

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

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

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

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

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

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

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

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

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

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

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

HISTORICAL LAND USE: The township was partially laid out in 1859 by Todd Withrow and finished in 1867 by George H. Hill. The section lines for your property were surveyed in October, 1874 by J. P. Maxwell. The Surveyor General's map of January 9, 1875 shows the Town of Williamsburg (twelve buildings) located at the south end of the property near the intersection of Old CO-7 (then known as the Ward Wagon Road) and current CO-7. The Pacific Mineral Survey never did yield much and was used as the site of a stamping mill, rather than as a mine. The Switzerland Trail Railroad attempted to develop the property as a summer resort and started construction of a resort hotel. Labor problems resulted in a gun battle in which several people were killed. Construction stopped and the unfinished lodge still stands as it was when abandoned.

The property was clearcut for firewood in the 1870s. Ranching never was very important in the immediate vicinity (The property contains no meadows or grass cover to be impacted by grazing.). The existing stand appears to have seeded onto the site following a fire which occurred about 1920.

The initial cut in a four-cut dwarf-mistletoe program was completed in 1994.

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

IMPACT ON NEIGHBORS & NEARBY COMMUNITIES: The dwarf-mistletoe infection-center is situated in the middle of the property so a disease-free corridor entirely surrounds it. Also, the building site is located near the south end of this infection-center. The result is a hilltop clearing with fully-stocked forest on all sides with an additional strip of USFS land on the west between your property and the highway. There will be little impact on neighbors or nearby communities.

LOCAL MARKETS: There is no commercial sawtimber on the property. The remaining lodgepole pole stands should be preserved as a privacy screen around the edge of the property. Only a tiny amount of firewood, not even a commercial sale, will result from anticipated cutting activities; you may wish to do your own cutting so as to use the wood yourself.

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

Threatened and Endangered Wildlife

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

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

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

The following plants are also listed:

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

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

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

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

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. No nests occur on your property.

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

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

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

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

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

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

Wildlife Habitat Opportunities

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

1. Create woodpecker and cavity-nesting bird habitat by killing selected trees and letting them stand. As trees die, they are attacked by woodborers and other insects which provide a food source 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.
2. Openings created by dwarf-mistletoe control can be used by western blue birds if there is adequate nesting cover nearby. These are snags located at 100-yard intervals around the perimeter of the meadows. 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. Bluebird nesting boxes may be substituted for snags when no suitable snag trees can be found.

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.

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-sharable.

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

The stand consists of 9.0 acres of over-stocked pole-sized lodgepole pine and 3.1 acres of understocked to non-stocked lodgepole pine type. Of the 3.1 acres, 1.2 acres fall within a Defensible Space zone around the proposed building site.

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

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

Defensible Space mainly serves to provide emergency access around the building so a fire crew can defend it without endangering themselves or their equipment. The practice is eligible for up to \$750 in cost-sharing money, but will not be funded until a building is actually present on site.

Money spent on Defensible Space activities can be added to the basis of the property for capital gains

treatment when the property is sold. Under current long-term capital gains, the savings will amount to an additional 28% of out-of-pocket cost.

2. Dwarf-mistletoe control. Dwarf-mistletoe is a parasitic green plant that attacks and kills coniferous trees. In this case, limber pine dwarf-mistletoe, is attacking limber and lodgepole pines and, possibly, a few other trees. It is extremely slow in its development and can take as long as fifty years from first attack to tree death (usually much less). A number of trees on the hilltop were heavily-infected and dying from it.

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

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

The Stewardship Incentives Program can currently reimburse dwarf-mistletoe work at 65% of actual cost, up to \$200 per acre (Per acre cost of a project completed last fall was \$308.33; work time was 19.67 hours per acre after heavily-infected trees were sold as firewood).

3. Tree planting. Following control of dwarf-mistletoe, the open areas (excluding the Defensible Space area) should be planted.

Reforestation plantings are eligible for up to \$410 per acre in Stewardship funding. An empty acre requires 390 seedlings (\$354.90), 2340 linear feet of 6-foot-width, weed barrier (\$780.00), 3510 staples (\$152.33) and \$38.62 in sales tax, for a total of \$1325.85 per acre. If you hire the work done, plan on another \$780 to plant the trees and \$1755 to lay weed barrier. Stewardship can reimburse 10.8% of this amount.

In your case, numerous trees would be left on-site by the dwarf-mistletoe work, reducing the number of seedlings needed to bring an acre to full stocking, but not

affecting the cost-share amount. The government would reimburse a much larger percentage of the actual cost.

In both practices you can do the work yourself and save the labor cost, as well as receiving cost-sharing for your labor.

Reforestation costs are eligible for special income tax treatment: Out-of-pocket costs are eligible for the 10% investment tax credit; in addition, they can be amortized over a seven-year period and deducted from income (seven-year amortization, six-month convention, straight-line depreciation). You would also save about \$130 on your State of Colorado income taxes. This brings the final cost to \$2009.53 (Various branches of government would have paid 48.0% of the cost.).

4. Wildlife habitat improvement. Besides the practices listed above, there is a rather large book of suggestions, ultimately listing hundreds of possible wildlife practices. One practice is required for participation in the Stewardship Incentives Program.

STEWARDSHIP "REQUIREMENTS":

First, if you don't accept the government's money, you are under no obligation whatsoever. You can carry out any combination or none of the above practices, the Colorado State Forest Service will help you do it, and there will be no commitment beyond cost of materials and CSFS service charges.

If you do accept cost-sharing money, the only practical "requirement" is the one to "maintain the practice" for ten years. This means if something should destroy the practice, you must replace it or refund the money. Even the replacement may be eligible for cost-sharing if it wasn't your fault (like a fire started by an unknown person). If you sell the property, you must convince the new owner to assume these responsibilities, or reimburse the cost-share money, as above. If you amortized reforestation costs and sell the property before ten years have passed, the deduction is subject to recapture; see your tax preparer for details.

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

Whether a practice is completed in the year shown, is not important. In this case, the order is not important either, except

that the dwarf-mistletoe work must be completed before planting practices can start; otherwise, there won't be space available for planting. This plan will be accepted as a basis for cost-sharing requests through September 30, 2005, so there is no rush.

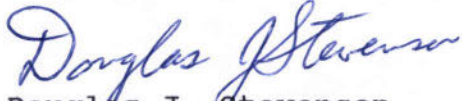
IMPLEMENTATION SCHEDULE:

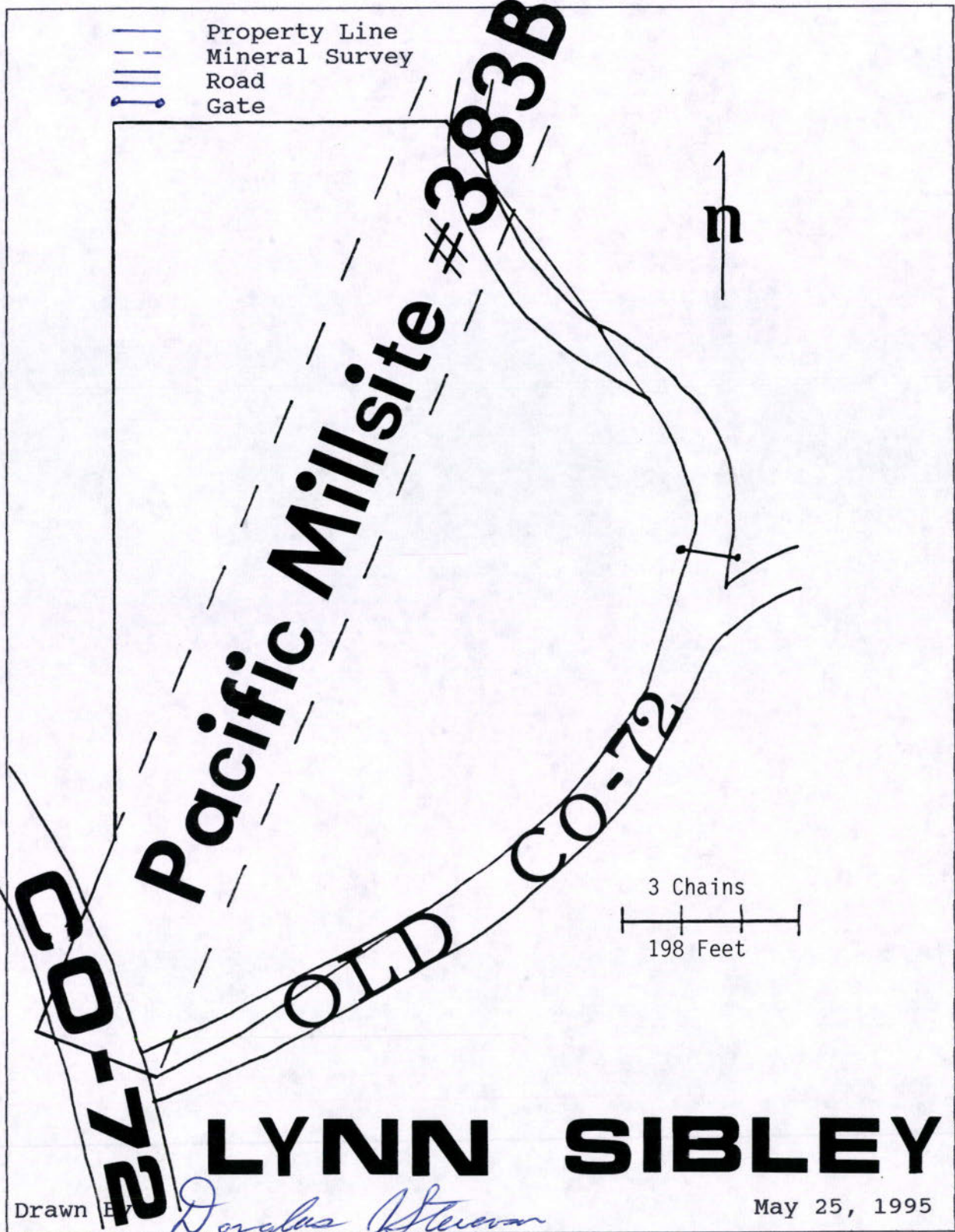
- 1995: Second dwarf-mistletoe cleaning. Trees are pruned free of all visible dwarf-mistletoe infections. Practice is cost-sharable. Many people prefer to do the work themselves. It is relaxing and not hard physically.
- 1996: Third dwarf-mistletoe cleaning. Treatment is the same as the first cleaning, except there won't be as many trees to prune.
- 1997: Fourth dwarf-mistletoe cleaning. Same as above. If all cleanings were thorough, this should be the last one. Because infections are easy to miss, a fourth cleaning is usually conducted.
- 1998: Fourth (and last) dwarf-mistletoe cleaning.
- 1999: Reforestation planting. Cost-sharable. Details are covered above.
- 2000: Maintenance planting. Expect to lose 10 to 15% of a planting during the first year. About 60 seedlings per acre need to be replaced. As there is no need to replace weed barrier, replacement is much cheaper. The Stewardship Incentives Program usually pays 65% of the cost.
- 2001: Defensible Space practice, if applicable.
- 2002: No activities.
- 2003: No activities.
- 2004: No activities.
- 2005: Revise and update this plan.

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



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

Textbook of Dendrology

DOUGLAS-FIR (Pseudotsuga menziesii (Mirb.) Franco

BOTANICAL FEATURES

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

Buds fusiform, sharp-pointed, lustrous brown.

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

GENERAL DESCRIPTION

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

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

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

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

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

ROCKY MOUNTAIN FORM

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

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

RANGE

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

ENGELMANN SPRUCE (Picea engelmannii Parry)

BOTANICAL FEATURES

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

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

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

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

GENERAL DESCRIPTION

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

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

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

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

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

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

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

RANGE

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

LIMBER PINE (Pinus flexilis James)

DISTINGUISHING CHARACTERISTICS

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

GENERAL DESCRIPTION

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

RANGE

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

LODGEPOLE PINE¹ (Pinus contorta Dougl.)

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 $\frac{3}{4}$ " 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 $\frac{1}{6}$ " long, ovoid, reddish brown, often mottled with black; wings $\frac{1}{2}$ " 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 $\frac{3}{4}$ " to 1" thick, deeply furrowed and transversely fissured, reddish brown to black and superficially scaly; that on mountain trees about $\frac{1}{4}$ " 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

¹So 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.

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.² The subsequent reproduction is

²According 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

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.)

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.

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.

GENERAL DESCRIPTION

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

Ponderosa pine is a large tree 150 to 180 feet high and 3 to 4 ft in diameter (On the best sites, 300-year-old dominant trees average about 175 ft high and 48 in. d.b.h.) (max. 262 by 8.6 ft). Even though this species commonly forms open parklike forests, the boles are ordinarily symmetrical and clear for one-half or more of their length; short conical or flat-topped crowns are characteristic of old trees. Four-year-old trees may have tap-roots four to five feet long. Moderately deep wide-spreading laterals develop as the trees get older. Ponderosa pine is not exacting in its soil requirements, but trees on thin, dry soils are usually dwarfed. Its occurrence on dry sites with the nut pines and certain of the junipers is indicative of its great resistance to drought. This species attains its greatest development, however, on the relatively moist but well-drained western slopes of the Siskiyou and Sierra Nevada Mountains of southern Oregon and California, respectively.

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

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

The rapidity of growth has a marked effect on the general appearance of the trees of this species. Young, vigorous specimens commonly develop dense crowns of dark foliage, and bark which is dark brown to nearly black, more or less corky, and deeply furrowed. In contrast, the foliage of old-growth or slow-growing trees is yellow-green, and the bark yellow-brown to cinnamon-red and plated. Those of the first type are generally called "bull" or "blackjack pines," and to some woodsmen ponderosa pine and bull pine are different trees. Fast-growth bull pines 150 years of age found near Cle Elum, Washington, measured 30 to 40 in. in diameter, while more typical ponderosa pines occurring in the same vicinity were only 10 to 14 inches in diameter at the same age. The growth of this species varies considerably with locality. In California, trees 120 years of age averaged 23 in. d.b.h., while in Arizona trees of the same age were only 16 in., and in the black hills 10½ in. Trees over 500 years of age are seldom encountered (Keen considers that this pine may reach an age of 800 years, while Mills reported a tree in southwestern Colorado with 1047 rings.). Severe damage is caused by bark beetles, and ponderosa pine is also attacked by more than 100 other kinds of insects. Fires kill seedlings and cause considerable damage even to large trees. Severe fires in the past have completely destroyed hundreds of thousands of acres of ponderosa pine forest. Other destructive agents include mistletoe and fungi.

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

RANGE

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

DWARF-MISTLETOE

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.

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

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

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

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

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

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

DWARF-MISTLETOE ADDENDUM

Douglas J. Stevenson
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.