FOREST STEWARDSHIP MANAGEMENT PLAN

For:

ELDORADO CANYON STATE PARK

Colorado Division of Parks and Outdoor Recreation
Eldorado Canyon State Park
Box B
Eldorado Springs, CO 80025

Parts of Tracts 92, 96, 98, 100, 101, 123, 124 and 132,
Township 1 South, Range 71 West,
Sixth Principle Meridian,
Boulder County, Colorado.

Prepared By:

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This management plan has been prepared at the request of the Colorado Division of Parks and Outdoor Recreation to guide forest management activities which are voluntarily applied on the property. Activities recommended in this plan are appropriate to meet Parks objectives and will benefit the natural resources on the property.

_____ _____

Parks and Outdoor Recreation Date

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EXECUTIVE SUMMARY

Eldorado Canyon State Park consists of two land units in the southern part of Boulder County. Inner Canyon is a highly-used recreation area and is of value chiefly for its aesthetic and recreational characteristics. Management here should be directed toward protection and preservation. There are three concerns in this regard: (1) dwarf-mistletoe is destroying the ponderosa pine stands north of the picnic area; (2) there is a lack of regeneration in the picnic area; and (3) stands north of the creek are at risk from fire during periods of extreme fire danger. An unusual botanic community in the riparian zone of Rattlesnake Gulch should continue to be protected.

Crescent Meadows is an old ranch. Its light dwarf-mistletoe infections should be monitored, but do not require treatment at this time. Spruce budworms have damaged the Douglas-fir component in the past, but are currently inactive. Ponderosa stands here are at risk from mountain pine beetles the next time an epidemic develops, but there is no immediate threat. A Defensible Space practice would reduce fire hazard along Gross Reservoir Road.

OBJECTIVES

The forestry objectives for this property are:

1. Consistent with the Forest Stewardship Program, to improve health and vigor of the forest and enhance its productivity.
2. Practice silviculture and multiple use management, giving particular attention to protection of wildlife habitat and recreational qualities of the area.
3. Preserve the aesthetic qualities of the property.
4. Protect soil and water resources.

GENERAL DESCRIPTION

Property Location

Inner Canyon adjoins Eldorado Springs at the west end of CO-170. The entrance gate is about 3.0 miles west of CO-93.

Crescent Meadows adjoins Crescent Siding of the Denver and Rio

Grande Western Railroad and lies northeast of the siding north of the right-of-way. It is on the east side of Gross Reservoir Road, about 2.0 miles north of CO-72.

Area: The property contains 845.0 acres, as determined from Boulder County Assessor's maps, which are not guaranteed for accuracy.

A breakdown by stand is shown below:

Inner Canyon:		
Stand A	68.4 acres	Ponderosa pine
Stand B	26.5 acres	Ponderosa pine/Douglas-fir
Stand C	34.1 acres	Douglas-fir
Stand D	25.9 acres	Douglas-fir
Stand E	32.0 acres	Douglas-fir/Aspen
	186.9 acres	FORESTED ACRES
Non-Forest	6.6 acres	
Picnic Area	5.4 acres	
Rock	102.2 acres	
	301.1 acres	TOTAL ACRES OWNED
Crescent Meadows:		
Stand A	92.6 acres	Douglas-fir
Stand B	68.0 acres	Ponderosa pine
Stand C	22.5 acres	Douglas-fir
Stand D	68.1 acres	Ponderosa pine/Douglas-fir
Stand E	5.1 acres	Douglas-fir/Ponderosa pine
Stand F	22.1 acres	Ponderosa pine/Douglas-fir
Stand G	54.4 acres	Ponderosa pine
Stand H	22.3 acres	Ponderosa pine
Stand I	27.2 acres	Ponderosa pine
Stand J	21.5 acres	Ponderosa pine
Stand K	13.9 acres	Douglas-fir
	417.7 acres	FORESTED ACRES
	106.2 acres	Meadow
	523.9 acres	TOTAL ACRES OWNED
	301.1 acres	Inner Canyon
	523.9 acres	Crescent Meadows
	825.0 acres	Eldorado Canyon State Park

Boundary Monuments: The General Land Office surveyed the township in 1926, marking each Tract corner with a brass cap.

According to the records, the following caps exist along the perimeter of Inner Canyon:

1. At the southeast corner of Inner Canyon, a cap marks the corner of Tract 92 to the northwest; Tract 132 to the southwest; Section 30, Township 1 South, Range 70 West to the northeast; and Section 31, Township 1 South, Range 70 West to the southeast. This is both a tract corner and a section corner.

2. At the northwest corner of Inner Canyon, a cap marks the corner of Tract 92 to the south, Tract 93 to the northeast, and Tract 94 to the west.

3. One-quarter mile east of Corner 92/93/94, a cap in the north line of Inner Canyon marks the corner of Tract 39 to the northeast, Tract 92 to the south, and Tract 92 to the north-west. This cap is located on the side of Rincon Wall.

4. One-quarter mile east of Corner 39/92/93, a cap in the north line of Inner Canyon marks the corner of Tract 39 to the northwest and Tract 92 in the other three quadrants. It is located on the northeast flank of Shirttail Peak.

5. At the northeast corner of Inner Canyon, a cap marks the west quarter-corner of Section 30 to the east and Tract 92 to the west.

6. One-half mile south of Corner 92/93/94, a cap in the west line of Inner Canyon marks the corner of Tract 92 to the northeast, Tract 94 to the northwest, Tract 130 to the southwest and Tract 132 to the southeast.

The original Inner Canyon property was located entirely in the south end of Tract 92. Later, the northwest quarter of the northwest quarter of Tract 132 was added.

Crescent Meadows is made up of parts of Tracts 96, 98, 100, 101, 123 and 124. According to the records, the following corners are marked:

1. In the north property line, a brass cap marks the corner of Tract 56 to the northwest (owned by the Bureau of Land Management), Tract 98 to the east and Tract 100 to the southwest.

2. One-quarter mile west of Corner 56/98/100, a brass cap in the north line of Crescent Meadows marks the corner of Tract 56 to the northeast and Tract 57 to the northwest (both owned by the Bureau of Land Management), and Tract 100 to the south.

3. One-quarter mile west of Corner 56/57/100, a brass cap in the north line of Crescent Meadows marks the corner of Tract 57 to the northeast (owned by the Bureau of Land Management), Tract 58 to the northwest (privately owned), and Tract 100 to the south. This corner is about 150 feet east of Gross Reservoir Road.

4. Near the north end of the east line of Crescent Meadows, one mile north of the Denver and Rio Grande right-of-way, a brass cap marks the corner of Tract 98 to the west, Tract 148 to the northeast and Tract 150 to the southeast (the latter two both owned by the Bureau of Land Management).

5. Entirely enclosed by Parks property, the corner of Tracts 98 (northeast), 100 (northwest), 101 (southwest) and 124 (southeast) is located southeast of the intersection of South Boulder Creek and Crescent Meadow Trails.

6. In the east line of Crescent Meadows, one-quarter mile south of Corner 98/148/150, a brass cap marks the corner of Tract 97 to the southeast (privately owned), Tract 98 to the northwest, Tract 124 to the southwest, and Tract 150 to the northeast (owned by the Bureau of Land Management).

7. Entirely surrounded by Parks property, a brass cap marks the corner of Tract 101 (northeast, northwest and southwest) and Tract 123 (southeast). It is on the hill southwest of the meadow and was located during field work.

8. Also entirely surrounded by Parks property, a brass cap marks the corner of Tract 101 (northwest), Tract 123 (south), and Tract 124 (northeast). This cap is in the meadow northeast of the buildings and is about 40 feet south of the creek near a patch of choke cherries. It stands at the intersection of two old fences and was located during field work.

9. One-quarter mile east of Corner 101/123/124, entirely surrounded by Parks land, a brass cap marks the corner of Tract 123 (southwest) and Tract 124 (northwest, northeast and southeast).

10. In the east line the Crescent Meadows property, one-quarter mile north of the railroad right-of-way, a brass cap marks the corner of Tract 97 (northeast), Tract 124 (west) and Tract 151 (southeast). Tracts 97 and 151 are privately owned. This cap is located beneath a north-south fence and was leaning downhill when it was ob-

served during field work. It will need to be re-established before it can be used as a survey reference.

11. The corner of Tracts 124, 125, 126 and 151 stands on the Denver and Rio Grande right-of-way, only feet south of the southeast property corner. Tunnel 18 is a few feet farther south. This corner has been destroyed and is marked only by a wooden fence post, which may not be exactly at the corner.

The east property line of Tract 124 is fenced, as is the Denver and Rio Grande right-of-way. Both fences need maintenance, but are easily seen. Gross Reservoir Road is the west property line. The 6800-foot contour line is the property line crossing Tracts 96 and 98. The north property line is unmarked, except for the brass caps mentioned above.

Access: Inner Canyon is accessed from the road along South Boulder Creek via the park's east gate. Fowler Trail might be accessible to low-profile, four-wheel drive vehicles in an emergency as might Rattlesnake Gulch Trail as far as the aqueduct. Elsewhere, there is no vehicle access; roads are undesirable due to high cost and adverse environmental impacts. Hiking trails provide foot access to most of Inner Canyon.

Crescent Meadows is accessible via Gross Reservoir Road. An old road along the railroad right-of-way provides access to the south property line. Old roads also provide access to the western half of the property. There are old haul roads south of the creek from salvage work done during the mountain pine beetle epidemic. The northeast quarter of the property has no vehicle access, but might be provided with it, should work be necessary in that area.

TOPOGRAPHY

Slopes and Aspects: Inner Canyon is just what its name implies - a canyon. North of South Boulder Creek aspects are southerly with slopes mostly about 50 to 60%, but in places vertical cliffs make stand maintenance difficult, or even impossible. South of the creek, aspects are northerly and there are fewer cliffs, but slopes are still extremely steep.

On Crescent Meadows, drainage runs southwest to northeast, so aspects are mostly northwest or southeast. Forested sites generally have slopes of 30 to 50%, right at the limit of accessibility. A few sites have slopes over 80% and are inaccessible.

Elevation: The lowest point in the park is the bed of South Boulder Creek by the entrance gate (approximately 5760 feet above sea level). Shirttail Peak with an elevation of 7357 feet above sea level is the highest point in Inner Canyon.

The lowest point on Crescent Meadows is where a draw crosses the east property line. Elevation is approximately 6720 feet above sea level. The highest point is the southwest hill near the Denver and Rio Grande right-of-way with an elevation of about 7525 feet above sea level.

Geology: Precambrian rocks now about 1.8 billion years old (Quartzite Ridge and Supremacy) were intruded about 1.7 billion years ago by Boulder Creek Granodiorite. This formation is bedrock throughout Crescent Meadows and most of Inner Canyon.

A north-northwest trending fault of Precambrian Age crosses Inner Canyon and passes beneath the town of Eldorado Springs. This fault is the source of Eldorado Warm Springs (Bilodeau, 1987) that gave rise to the town. The fault has occasionally been reactivated.

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

Old Mesa Trail crosses the park on Benton shale and the hill in the northeast corner stands on the Niobrara Formation. In the Early Cretaceous period the area began to subside and was eventually buried under almost 10,000 feet of marine sediment (Pierre Shale that doesn't quite reach park land).

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 and sedimentary

formations along Inner Canyon's eastern boundary into position occurred during the Laramide Orogeny.

Intrusive volcanic activity occurred to the northeast during the Paleocene, creating the Valmont dike and other igneous formations, 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.

A tiny area of Rocky Flats alluvium (Age: one to two million years) occupies park property on either side of Eldorado Springs. This corresponds to the Nebraskan or Aftonian glaciation. Though there are numerous other Quaternary deposits nearby, they do not occur on park property, except as valley fill along South Boulder Creek.

Neither property has ever been glaciated (The nearest glacier reached Nederland.), although Wisconsin-age and later climate fluctuations have had major impacts on plant life and continue to have an effect, even now.

SOILS: Soil identifications below are taken from Moreland's Soil Survey of Boulder County Area, Colorado and are accurate to soil series. Specific soil types are available through the Denver office of the USDA - Soil Conservation Service.

Baller stony sandy loam occurs in a small pocket in the northeast corner of Inner Canyon on a southeast-facing slope. It is shallow and well-drained, formed in loamy residuum weathered from sandstone (the Niobrara Formation; see above). Slopes are 9% to 35%; elevations range from 6120 to 6220 feet above sea level on park land. Climax vegetation is of the ponderosa pine/Arizona fescue ecotype. Some Rocky Mountain juniper also grows here. Annual precipitation is 16 to 20 inches of rainfall per year. The frost-free season is 140 to 155 days.

The surface layer is grayish-brown stony sandy loam about 10 inches thick. The under-lying layer is light brownish-gray very stony sandy loam, about 5 inches thick, that overlies hard sandstone.

Large amounts of stone lie on the surface and throughout the profile. Included soils and bedrock make up about 20% of the mapped area. Runoff is rapid with a high erosion hazard. (Capability unit VIIs-1, non-irrigated; tree suitability group 6). Recommended silvicultural activities: none. Protect the area from disturbance; productivity is too low to justify the risk of

damaging the site.

Colluvial land occurs in long narrow valleys, generally running north-south. It occurs on lower slopes along the east side of Inner Canyon, east of the entrance gate. Elevation ranges from about 5880 to 6200 feet above sea level on park land.

The soil varies widely in depth, texture, color, reaction and stoniness. The surface layer is mostly a sandy loam, containing stones and cobbles. The underlying layer can vary from loamy sand to clay. Lime content varies from strongly calcareous to noncalcareous. Reaction is usually slightly alkaline. Most colluvial land is dark, but some can be light. Erosion hazard is high (Capability class VIIs-1, non-irrigated; tree suitability group 6).

On park property, this soil type is occupied mostly by grass and does not enter into the forest management aspects of this plan. Silvicultural practices do not apply.

Ferncliff stony sandy loam occurs on Crescent Meadows at elevations from 6720 to 7390 feet above sea level, mostly on north-facing slopes.

These soils occur in loamy mixed alluvium on short fans and valley side slopes. Slopes run from 15% to 60%. This soil is occupied by the ponderosa pine/Douglas-fir ecotype. Annual precipitation is 18 to 24 inches; the frost-free growing season is 80 to 120 days.

The surface layer (A1) is composed of dark grayish-brown stony sandy loam and is about three inches thick. The subsurface layer (A2) is composed of light-gray stony sandy loam and is about 17 inches thick. The subsoil contains A&B and B&A horizons. Rock occurs at depths of 60 to 80 inches.

Permeability is moderate to moderately rapid; available water capacity is moderate; root penetration is 60 inches; moderate amounts of stone occur throughout the profile. Reaction is slightly acid at the surface to medium acid in the subsurface, becoming slightly acid again in the subsoil.

Erosion hazard is slight (Land capability group VIIe-1, nonirrigated; tree suitability group 1). Standard silvicultural practices apply.

Ferncliff-Allenspark-Rock Outcrop Complex occurs on Crescent Meadows and is made up of about 30% Allenspark gravelly sandy loam, 30% Ferncliff stony sandy loam and 20% rock outcrop under standard mapping procedures. On park land, Allenspark soils do not occur. Included are small areas of Juget and Peyton soils and narrow strips of alluvial soils along drainage, which together

make up about 20% of the mapping unit.

Elevations range from about 6720 to 7390 feet above sea level on park property.

Runoff is medium to rapid; erosion hazard is high (Land capability group VIIe-1, nonirrigated; tree suitability group 1). Standard silvicultural practices apply.

Juget very gravelly sandy loam occurs on slopes and ridges in sandy residuum weathered from granite. On park land it occurs in the extreme southwest corner of Inner Canyon and on ridge-tops in Crescent Meadows. It is shallow and excessively-drained. Slopes range from 9 to 55%; elevation ranges from about 7300 to 7525 feet above sea level. It is occupied by the ponderosa pine/Douglas-fir ecotype. On Crescent Meadows, this soil underlies much of the meadow. Annual precipitation is 14 to 18 inches; the frost-free growing season is 80 to 120 days.

The surface layer (A1) is dark-gray very gravelly sandy loam about 5 inches thick. There is no subsoil. The C horizon consists mostly of decomposed granite. Hard granite occurs at a depth of 11 inches.

Soil reaction is slightly acid; permeability is rapid; available water capacity is low; root penetration is less than 20 inches. Vegetation is of the ponderosa pine/Douglas-fir ecotype. Grass cover should always be maintained to prevent erosion.

Runoff is rapid; erosion hazard is high (Land capability class VIIs-1, nonirrigated; tree suitability group 2).

Juget-Rock Outcrop Complex occurs on the ridgetop in the southwest corner of Inner Canyon. It consists of about half Juget very gravelly sandy loam and about 30% Rock Outcrop. Small inclusions of Peyton soils may occur, making up as much as 20% of the unit. Allenspark soils do not occur in this unit on park property.

Runoff is rapid with high erosion hazard (Land capability class VIIs-1, nonirrigated; tree suitability group 2).

Peyton very gravelly loamy sand underlies the meadow in Crescent Meadows. It is a deep, well-drained soil on upland hills and valley side slopes consisting of weathered loamy and sandy material that has been locally transported.

Slopes are 5% to 20%; elevation on park land ranges from about 7100 to 7450 feet above sea level; vegetation is mainly tall grass in the ponderosa pine/Douglas-fir ecotype. Annual precipitation is 18 to 24 inches and the frost-free season is 80 to 120 days.

The surface layer (A1) is dark-gray very gravelly loamy sand about 11 inches thick. The subsoil (B1t and B2t) is composed of brown gravelly sandy clay loam about 32 inches thick, grading to gravelly coarse sandy loam. Soil reaction is neutral. Soil depth often exceeds 60 inches.

Permeability and available water capacity are moderate; root penetration reaches 40 to 60 inches. Standard silvicultural prescriptions do not apply.

Runoff is slow to medium; erosion hazard is moderate to high (Land capability class VIIs-1, nonirrigated; tree suitability group 2).

Peyton-Juget very gravelly loamy sands occur beneath the meadow in Crescent Meadows. The complex consists of about 65% Peyton very gravelly loamy sand and 20% Juget very gravelly loamy sand. Peyton soils form the main area of the meadow, with Juget soils around the edges and on low ridges within it. Included are some small areas of rock outcrop and a dark-colored alluvial soil with a high water table along the stream.

Runoff is slow to medium; erosion hazard is moderate to high (Land capability class VIIs-1, nonirrigated; tree suitability group 2).

Rock Outcrop occurs over most of the Inner Canyon west of the entrance gate, except for a ridgetop area of Juget-Rock Outcrop Complex on the ridge west of Rattlesnake Gulch. The mapping unit consists of exposed bedrock and mixed materials including granite, sandstone, shale and limestone (Limestone does not occur on park property.). Included are shallow soils on areas of lesser slope, areas of mixed colluvium near the bottom of slopes and alluvium along streams.

Watershed protection is the standard silvicultural practice (Land capability group VIIIs-1; no tree suitability group established).

Sixmile stony loam occurs on the southwest slope of the ridge at the northeastern end of Inner Canyon. It is deep and well-drained. It occurs on ridges and side-slopes in calcareous loamy residuum weathered from shale (Niobrara Formation). Slopes are 10% to 50%; elevations range from 6000 to 6200 feet on park land. Vegetation is mostly mid-height grasses. Annual precipitation is 14 to 18 inches and the frost-free season is 120 to 140 days. The mapping unit includes some rock outcrop and colluvial land.

The surface layer (A1) is strongly calcareous, reddish-brown stony loam, about four inches thick. There is no B horizon. The subsoil horizons (C1, C2 and C3) consist of shale in decreasing degrees of decomposition.

Permeability is moderate; available water capacity is moderate to high; root penetration is 20 to 40 inches. Silvicultural practices do not apply (Land capability group VIIs-1; tree suitability group 6).

Land capability class VIIe-1 (Nonirrigated). Major uses of these areas consist chiefly of forests and wildlife. Standard silvicultural practices are needed to prevent soil erosion. Protection from fire, insects and disease is needed to protect the soil. Thinning activities are feasible. If grazed, no more than half of the current year's growth should be removed. Arizona fescue, mountain muhly and pine dropseed increase under proper grazing. Grass seeding not practical because of rock and trees.

Land capability class VIIs-1 (Nonirrigated). These sites are generally used for range and wildlife practices. Special care is needed in applying silvicultural practices. Permanent vegetation should be maintained. Suitable range grasses include big bluestem, little bluestem, needlegrass and side-oats grama. A maximum of half the vegetation may be grazed each year. Grass seeding is difficult or impossible due to steep terrain, rocks and stones.

Land capability class VIIIs-1. These sites need protection to maintain plant cover. There main use is as watershed land and wildlife areas. Silvicultural activities are not advisable due to the fragile nature of the soil. Human use should be largely limited to trails which are constructed to avoid concentrating water.

LOCAL MARKETS

Sawtimber markets in Boulder and vicinity are severely limited and irrelevant to anticipated activities on park land. Firewood markets are weaker than they were ten years ago, but still readily able to handle any expected cutting. For the most part, little cutting is needed or desirable, except for dwarf-mistletoe control, most of which is located in areas that cannot be accessed for commercial cutting.

TYPOLOGY AND STAND IDENTIFICATION

Western forests are typed by the dominant tree species occurring, provided that species makes up at least 20% of stocking. When no species makes up at least 20% of the stand, the type is listed as "mixed." All stands on Eldorado Springs State Park are dominated by a single species. When subdominant species make up at least 20% of the stand, they are also listed.

Size classes are as follows:

Class 1A: Seedlings (Less than 4.5 feet tall).
Class 1B: Saplings (4.5 feet tall to 5.0 inches DBH).
Class 2A: Small poles (5.0 to 7.0 inches DBH).
Class 2B: Large poles (7.0 to 9.0 inches DBH).
Class 2C: Near-merchantable (9.0 to 11.0 inches DBH).
Class 3A: Small sawtimber (11.0 to 15.0 inches DBH).
Class 3B: Medium sawtimber (15.0 to 21.0 inches DBH).
Class 4: Large sawtimber (21.0+ inches DBH).
Class 5: Large old growth (21.0+ inches DBH and dating from pre-settlement).

A stand is classified by adding together stocking figures, starting with the highest class, until a minimum level of 325 trees per acre, 10 square feet of basal area per acre or 1500 board feet per acre is obtained over a minimum 3.0-acre area. This means that trees larger than the listed size class may occur in small numbers. Classes 2C through 5 are typed by board foot volume; classes 1B through 2B are typed by basal area and class 1A is typed by stem count.

Pre-settlement stands in Boulder County are those with stand birthdates (See below.) of 1850 or earlier (Age: about 140 years). There are no Class 4 or Class 5 stands on Eldorado Canyon State Park.

Stand birthdates are determined by taking mean age weighted by volume, basal area or stem count, as above, and subtracting that from the current year, rounding the result to the nearest decade. It is possible for a younger, faster-growing class of trees to overtake an older, slower-growing class and change the stand birthdate, without any other change in the stand.

Multiple classes: Real stands are rarely even-aged or all-aged, but consist of in-between mixes. Second and third classes of trees are typed as if they were separate stands, but the result is listed along with the dominant class. Second and third classes frequently differ from the dominant class.

Typology:

Inner Canyon

Stand A: Ponderosa pine, small sawtimber (Class 3A), lightly stocked, birthdate: 1860.
Stand B: Ponderosa pine, small sawtimber (Class 3A), medium stocked with associated Douglas-fir, birthdate: 1860.
Stand C: Douglas-fir, large poles (Class 2B), heavily stocked with associated ponderosa pine, birthdate: 1890.
Stand D: Douglas-fir, large poles (Class 2B), heavily stocked with associated ponderosa pine, birthdate: 1890.

Stand E: Douglas-fir, large poles (Class 2B), heavily stocked with associated ponderosa pine and aspen, birthdate: 1890.

Crescent Meadows:

Stand A: Douglas-fir, large poles (Class 2B), heavily stocked, birthdate: 1890.

Stand B: Ponderosa pine, large poles (Class 2B), medium stocked, birthdate: 1890.

Stand C: Douglas-fir, large poles (Class 2B), heavily stocked, birthdate: 1890.

Stand D: Ponderosa pine, large poles (Class 2B), medium stocked, birthdate: 1890 (This stand contains an included patch of Douglas-fir that was less than three acres.)

Stand E: Ponderosa pine, small sawtimber (Class 3A), medium stocked with associated Douglas-fir, birthdate: 1890.

Stand F: Ponderosa pine, small sawtimber (Class 3A), medium stocked with associated Douglas-fir, birthdate: 1890 (This stand contains an included riparian zone that was less than three acres.).

Stand G: Ponderosa pine, large poles (Class 2B), medium stocked, birthdate 1890.

Stand H: Ponderosa pine, small sawtimber (Class 3A), medium stocked with associated Douglas-fir, birthdate: 1890.

Stand I: Ponderosa pine, large poles (Class 2B), lightly stocked, birthdate: 1890 (This stand contains two included meadows that were both less than three acres.)

Stand J: Ponderosa pine, small sawtimber (Class 3A), with associated Douglas-fir, birthdate: 1890.

Stand K: Douglas-fir, large poles (Class 2B), medium stocked, birthdate: 1890.

Meadow: The meadow contains two included patches of ponderosa pine that were less than three acres.

LAND USE

CURRENT: Inner Canyon and Crescent Meadows are both being used for recreational purposes, as part of Eldorado Canyon State Park. Of primary concern are the aesthetic and recreational values, followed by protection of existing resources. Product values are not considered, except as a means to achieve the other values.

HISTORICAL: The current forest typology on Eldorado Canyon State Park originated following a major climatic shift at the end of the Pleistocene, about 11,000 years ago. Species that now occur at the west end of Crescent Meadows, such as ponderosa pine and

Douglas-fir, extended far out onto what is now the Great Plains. Species now common around 9000 feet of elevation, such as lodgepole pine, Engelman spruce and subalpine fir grew on Crescent Meadows. In addition, many plant species that now exist only in moist refuges were common throughout the park.

During the Altithermal, about 7000 to 9000 years ago, the climate became even warmer and dryer than it is now. Plant species once common, became restricted to moist areas near small streams on north-facing canyon walls. Rattlesnake Gulch is such a stream and a number of plants, although neither rare nor endangered, make use of it as a refuge and should receive extra consideration in any plans affecting it.

The current forest originated about 1760 following a major fire. This is surmised from the existence of a class of Douglas-fir, all dating from about the same decade. The only known agent capable of large-scale land clearing over thousands of acres, is fire.

About 1853 a large fire burned the area west of Boulder, including Crescent Meadows and, possibly, parts of the Inner Canyon. According to local legend, this fire was set by Arapahos, angry at being cheated by whites. One suspects this legend sprang up later so that whites would not have to take the blame for settlers' carelessness.

Nearly all of Crescent Meadows was logged about 1880, as were lower slopes of the Inner Canyon (The higher slopes around Shirttail Peak were apparently not considered economical and so were not cut; the higher portions of Stand A and Stand B are virgin as a result.).

Crescent Meadows was a working ranch since the 1870s. It was common practice for homesteaders to buy up land with meadows or water, then graze surrounding government land without paying for the privilege. There is potential to rebuild this ranch for operation as a living-history museum.

A title search, which frequently reveals much of a property's history, was not done in this case due to financial constraints.

The Inner Canyon has never had significant amounts of use for anything other than recreation. When Eldorado Warm Springs was popular as a spa, the scenic cliffs and rock formations served as an added tourist attraction. They still serve this function.

Ponderosa stands, particularly those on Crescent Meadows, were heavily damaged by mountain pine beetles during the 1970s. Thinning work was done to enhance stand resistance to attack. Resulting openings are now being colonized by Douglas-fir seedlings.

DESIRED CONDITIONS

Healthy, vigorous, fully-stocked stands of trees are required by the Forest Stewardship Program which is providing 68% of funding for this plan (Colorado Division of Parks and Outdoor Recreation provided about 24%; 8% was donated by Elk Falls, an environmental consulting and contracting company.). This condition need not be achieved immediately, but progress should be made in this direction.

For the protection of the park's ponderosa pine stands, it is desirable to reduce dwarf-mistletoe to an infection rate less than 10% of trees on the property (an average dwarf-mistletoe rating of 0.3). Ponderosa pine stands in Crescent Meadows are close to this level, now. Those in Inner Canyon have much higher ratings.

It would be desirable to increase the park's usefulness to wildlife, indirectly enhancing the park experience for visitors. In particular, nesting sites for cavity-nesting birds in both park units and food and shelter plantings around the edge of Crescent Meadow would be beneficial.

IMPACT ON NEIGHBORS & NEARBY COMMUNITIES

Very little silvicultural work is needed on either park unit, aside from dwarf-mistletoe control. Minor amounts of wood may be removed from Crescent Meadows, resulting in temporary use of Gross Reservoir Road (Needed dwarf-mistletoe work may also be done non-commercially; in which case, nearby neighbors will probably not be aware that anything is happening.). As commercial wood sales are impossible on steep terrain in the Inner Canyon, control work will be non-commercial. Local residents are unlikely to realize that anything is being done.

Most control sites will be located away from roads so they won't be visible to the casual visitor. Signs can explain things to the hiker who is ambitious enough to go into the woods.

There will be little visual impact as a result of control efforts and the amount of wood contributed to the local firewood market, if any, will be insignificant.

INVENTORY

There follows, a stand-by-stand description of forest resources, including all stands in both park units.

INNER CANYON:

Stand A: This is a ponderosa pine, small sawtimber stand. It contains a few Douglas-firs and Rocky Mountain junipers. Sawtimber stocking totals about 1800 board feet per acre, on average. The stand averages 32 square feet of basal area per acre, or about 54 trees. The stand originated about 1860, apparently following a fire. Many older trees on the upper slopes indicate an area that did not burn.

Note on stand typology: In single-species stands without associated species, the type species makes up at least 80% of total stocking (See TYPOLOGY AND STAND IDENTIFICATION, page 14, above.). In two-species stands, the type species makes up a plurality of stocking with associated species making up at least 20% of total stocking. Eldorado Canyon State Park has no three-, four-, or mixed-species stands. Two-species stands on park land consist of about 70% type species and about 30% associated species. See Dilworth, Log Scaling and Timber Cruising, for more information.

The stand is lightly stocked, due mainly to dwarf-mistletoe. On the lower slopes this has advanced to a state where the disease is destroying the stand. During the mountain pine beetle epidemic, beetles attacked stands that were weakened by dwarf-mistletoe. The result was a patch-work mosaic of "hot-spots." These "hot-spots" are now non-stocked patches within the stand that contain only small trees, heavily-infected with dwarf-mistletoe. The mistletoe survives on these, infecting new seedlings, if any should become established. "Mountain pine beetle" damage in this stand was predisposed by dwarf-mistletoe. Inaction will result in destruction of the remaining large ponderosas over a period of a few decades. With a disease reservoir remaining on small, deformed trees few seedlings will be able to escape infection long enough to reach maturity and ponderosa pine will become an insignificant component of a stand it once dominated.

If left untreated, dwarf-mistletoe will eventually kill the ponderosa pine component. The site will be dominated by Rocky Mountain junipers rather than Ponderosa pine/Douglas-fir. Wildlife will shift toward early-successional species. Fuels will shift toward finer, flash fuels and away from slow-burning types. Aesthetically, there will probably be little effect, as the forest will change so slowly that most people will not notice. For rock climbers, there would be no effect at all; people will be able to see the changes from the picnic area if they know what to look for.

Note: It is far too late to create and maintain a "natural" environment within Eldorado Canyon State Park. Fire is the only natural means of controlling dwarf-mistletoe. As it is politically inexpedient to allow fire of any kind to burn freely in the park, another (human) means of control is needed to halt the spread of dwarf-mistletoe and keep ponderosa pine in the stand.

The road runs along the southern (lower) edge of this stand. Across the road, the picnic area provides an ignition source for fire. Should a fire escape and reach the north side of the road, it would rapidly spread up the steep slopes. If the fire were driven by a southwest wind (as are most of our local, large fires) the slope could quickly become an inferno, trapping hikers or climbers above. The only access for fire-fighting is the Eldorado Canyon Trail. Fire would have to be fought with hand crews, slurry bombers and helicopters. This would be an expensive fire; it would not likely be stopped before reaching the top of Shirttail Peak and crossing onto Boulder Mountain Park land to the north.

The stand should be closed during periods of extreme fire danger. Most people are careful to obey rules about smoking on trails and portable grills; a few are not. During ordinary conditions, this is not likely to be a significant problem, but during extremely dry periods, gusty south and southwest winds, or Red Flag conditions, even a single ignition could be serious.

The stand is separated from the picnic area by a road. This offers an opportunity to stop a fire before it has a chance to run up the hill. To allow no open fires in the picnic area during hazardous conditions would probably suffice to protect Stand A.

Operations of any kind are limited by steep terrain and fragile soils. Commercial harvesting is not feasible. Only non-commercial (someone is paid to do the work) dwarf-mistletoe control by girdling is anticipated. Foot access to this stand is accomplished by hiking in on Eldorado Canyon Trail, then contouring to reach a particular site.

A small, intermittent creek passes through this stand. There is no wetland vegetation associated with it. When the creek has water, rapid flow tends to scour out any vegetation. There are no riparian zones or wetland features in this stand.

Silvicultural objectives for this stand are:

1. Control dwarf-mistletoe to protect the appearance of the stand (This includes planting patches with new seedlings after infected trees have have been

killed.).
2. Create nesting sites for cavity-nesting birds. Both objectives can be accomplished by girdling infected trees in patches of about 4.5 acres per year, waiting until the girdled trees die, then planting with ponderosa pine seedlings.

No cultural features were observed in this stand.

No noxious weeds, other than a few scattered thistles, were observed. Dry conditions and poor, rocky soils will keep most weeds in check (Note: Colorado's weed law does not identify particular species of plants as weeds. Any plant can be a weed if enough people do not like it; conversely, a plant formerly considered a "weed" may cease to be one. The definition of "weed" is arbitrary and subject to local political manipulation; it changes from time-to-time and place-to-place.).

Woodpecker damage (red-shafted flickers?) was observed on several trees during field work. Nuthatches, chickadees and several other small birds were using moist micro-sites under a Douglas-fir canopy just below Rincon Wall. No activities are planned that would affect these birds. The moist micro-sites should be avoided altogether.

The property is located in the Georgetown block on the threatened and endangered species list. Protected species in this block include:

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

For the most part, these species do not make use of the area. The tern is a shore bird and prefers large lakes and rivers; and South Boulder Creek does not support cutthroat trout. The montane skipper occurs only in Cheeseman Canyon and its tributaries and does not reach Eldorado Canyon State Park.

This stand contains potential nesting sites for both bald eagles and peregrine falcons; although, none were observed during field work. Golden eagle and peregrine falcon nesting sites occurring just off park property and a prairie falcon nest in Stand C, suggest the need to carefully examine the stand before any work is done. Protecting these nesting sites is not only required by Federal law, it is well worth the few trees that will be lost to dwarf-mistletoe as a result. It is also within the hunting territory of

a falcon nest near Twin Sisters.

No endangered or threatened plant species were observed (A thorough survey would require repeated visits to likely sites throughout the course of a year, something beyond the scope of this plan.).

Lower portions of this stand are within the primary viewing area of park visitors. This offers both challenges and opportunities: the challenge is to carry out operations without significant visual impact and the opportunity is to interpret this to the public through signs and, possibly, a self-guided tour. Upper portions of the stand are difficult to reach and will be seen only by hikers and dedicated rock climbers.

There are no known archeological sites within this stand.

Stand B: This is a ponderosa pine, small sawtimber stand with associated Douglas-fir. It contains a few Rocky Mountain junipers. Sawtimber stocking totals about 2300 board feet per acre, on average. The stand averages 48 square feet of basal area per acre, or about 85 trees. The stand originated about 1860, apparently following a fire. Older trees indicate that much of this stand did not burn.

Dwarf-mistletoe is present, but is less of a problem than in Stand A. This stand should be considered low-priority for dwarf-mistletoe control. Insects are not a problem, except in patches where dwarf-mistletoe predisposes ponderosa pines to mountain pine beetle attack. This stand was too low to be seriously attacked during the spruce budworm epidemic and too high to be heavily impacted by mountain pine beetles. The few trees susceptible to spruce budworm are mostly dead already.

This stand is a long way from an ignition source (people). Lightning is the most-likely cause of a fire here. During the severe burning conditions, southwest winds would create a vortex behind the ridge, causing violent and unpredictable fire behavior. During ordinary conditions, fire is not likely to present a serious problem.

Operations of any kind are limited by steep terrain, fragile soils and remote location. Commercial harvesting is not feasible (There are no roads and no way to build them.). Only non-commercial dwarf-mistletoe control is possible and this is of low priority. All equipment and supplies must be hand-carried from Old Mesa trailhead.

There is no vehicle access and no trails.

There are no riparian or wetland areas in this stand.

Difficult location precludes silvicultural activities.

No cultural features were observed in this stand.

Dry conditions and poor rocky soils will keep most weeds in check (See comments at the top of page 21.).

A few small birds were observed using moist micro-sites under Douglas-firs. No activities are planned in this stand; there will be no effect on wildlife.

The property is located in the Georgetown block on the threatened and endangered species list (See comments on page 21; there are no known nesting sites in this stand.).

This stand is visible from Eldorado Springs and the old Mesa Trail, but is not visible from the park's primary use area. As no activities are planned here, there will be no change in scenic or aesthetic qualities of the stand.

There are no known archeological sites within this stand.

Stand C: This is a Douglas-fir, large pole stand with associated ponderosa pine. Sawtimber stocking totals about 1000 board feet per acre, on average. The stand averages 112 square feet of basal area per acre, or about 223 trees. It stand originated about 1890, apparently following a fire (The Boulder Canyon Fire of 1889 burned much of the area west of Boulder; this may have been the fire.). The stand is heavily stocked due to dense regeneration that became established after the fire.

This stand was located below the level reached by the spruce budworm epidemic of six-to-ten years ago and so, did not suffer damage. As a result, trees are too dense and growing poorly. The site is wet enough that mountain pine beetles did little damage during the pine beetle epidemic. This also contributed to over-stocking. At present there is little disease or insect risk.

In dry conditions, this stand would burn readily, if ignited. Fortunately, though trees go clear to the road, rock walls make it difficult for someone to accidently do so. Also, north aspect and steep terrain keep this site wetter than other nearby sites. During extreme conditions, prevailing winds are most-likely to come from the southwest (moving downhill) or west (sidehill), making fire less severe than it would be just across the canyon.

Operations of any kind are limited by steep terrain and fragile soils. Commercial thinning is possible, but difficult, adjacent to Fowler Trail and Rattlesnake Gulch Trail as far as South Boulder Diversion.

Rattlesnake Gulch is the western boundary of this stand. A narrow strip along this semi-permanent creek is the only riparian area in the stand. There is no wetland, as determined by hydrophilic plants, but this narrow strip contains an assortment of plants such as blue cohosh, Oregon-grape, Solomon's seal, rattlesnake plantain and others that, if not rare, is at least unusual in this area and should be protected. No cutting should be done here; no trails should be built in the riparian area.

There are no silvicultural objectives for this stand. Access problems and the need to protect the scenic and aesthetic qualities of the park preclude any cutting work.

The old road, now Fowler Trail, might be considered a cultural feature. Otherwise, there are no known cultural features in this stand.

No noxious weeds were observed.

Small birds make extensive use of this stand. No activities are planned that would affect them.

The stand is located in the Georgetown block on the threatened and endangered species list (See page 21.). There is a prairie falcon nest that should be protected (As no cutting activities are anticipated in this stand, this should not be a problem.).

Lower portions of this stand are within the primary viewing area of park visitors. This site should be left alone to preserve the scenic qualities of the park.

There are no known archeological sites within this stand.

Stand D: This is a Douglas-fir, large pole stand with associated ponderosa pine. Sawtimber stocking totals about 1100 board feet per acre, on average. The stand averages 108 square feet of basal area per acre, or about 203 trees. It stand originated about 1890, apparently following the Boulder Canyon Fire of 1889. The stand is heavily stocked due to dense regeneration that became established after the fire.

This stand was located below the level reached by the spruce budworm epidemic of six-to-ten years ago and so, did not

suffer damage. As a result, trees are too dense and growing poorly. The site is also wet enough that mountain pine beetles did little damage to it during the pine beetle epidemic. Again, this has resulted in over-stocking. At present, there is little disease or insect risk.

In dry conditions, this stand would burn readily, if ignited. As in Stand C, though trees go clear to the road, rock walls make it difficult for someone to accidently do so.

North aspect and steep terrain keep this site wetter than other nearby sites. During extreme conditions, prevailing winds are most-likely to come from the southwest (moving downhill) or west (sidehill), making fire less severe than it would be just across the canyon. The only practical access is for foot traffic via Rattlesnake Gulch Trail. This would be a dangerous place for fire crews.

Operations of any kind are limited by steep terrain and fragile soils. Commercial thinning is not feasible because of lack of access.

Rattlesnake Gulch is the eastern boundary of this stand. A narrow strip along this semi-permanent creek is the only riparian area in the stand. There is no wetland, as determined by hydrophilic plants. The riparian zone is the same one described in Stand C (See pages 23 and 24, above.).

There are no silvicultural objectives for this stand. Access problems and the need to protect the scenic and aesthetic qualities of the park preclude any cutting work.

There are no known cultural features in this stand.

No noxious weeds were observed.

Small birds make extensive use of this stand. No activities are planned that would affect them.

The stand is located in the Georgetown block on the threatened and endangered species list (See page 21, above.). There are no known nesting sites within this stand.

Lower portions of this stand are within the primary viewing area of park visitors. This site should be left alone to preserve the scenic qualities of the park.

There are no known archeological sites within this stand.

Stand E: This is a Douglas-fir, large pole stand with associated Douglas-fir. There is an aspen small pole class. Sawtimber stocking totals about 2800 board feet per acre, on average. The stand averages 122 square feet of basal area per acre, or about 287 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

Like Stands C and D, this stand escaped the budworm epidemic and as a result, is now overstocked. Stand structure, with the aspen class, probably contributed to this. Fomes igniarius (false tinder-fungus) is common in the aspen, as are bark cankers.

This stand is accessible only by hiking trail. If ignited, it would burn readily, but it is a long way from most park visitors, so the chance of ignition is low. This would be a difficult and costly fire to fight as it is accessible only to hand crews and aircraft. The north aspect means wetter sites and less wind exposure than on sites across the valley, so fire intensity will generally be less here than on nearby sites.

Operations of any kind are limited by steep terrain, fragile soils and difficult access. Commercial harvesting is not feasible. All equipment and supplies must be hand-carried up a steep, winding trail. There is no vehicle access.

Rattlesnake Gulch passes through the stand. The only riparian area is along it (See pages 23 and 24.). There is no wetland vegetation associated with it.

There are no silvicultural objectives for this stand. Difficult access makes such work impossible.

No cultural features were observed in this stand.

No noxious weeds were observed.

Deer make use of Rattlesnake Gulch as a water source. Mostly, they live on the State School Section (now owned by the City of Boulder) to the south, coming here for water. Several woodpecker nesting holes were observed; though, none were active at the time. Bear scats were also observed. No activities are planned in this stand.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.). There are no known eagle, hawk, falcon or owl nesting sites

There are no known archeological sites within this stand.

CRESCENT MEADOWS:

Stand A: This is a Douglas-fir, large pole stand, heavily-stocked. It contains a few ponderosa pines, but not enough to include in the type description. Sawtimber stocking totals about 1200 board feet per acre, on average. The stand averages 125 square feet of basal area per acre, or about 254 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the budworm epidemic, but damage was not serious. Ponderosa pines are too sparse to support a significant dwarf-mistletoe infection.

The greatest fire hazard in this stand is along Gross Reservoir Road on the western edge where motorists provide an ignition source. The eastern half consists of roughly, the top half of the south canyon wall of South Boulder Creek. There is only a hiking trail here and access is controlled, so ignition is not as likely. If the stand should ignite, fire would race to the top of the hill where it would be easily reached by strike teams equipped with trucks. Hand crews would have to work the canyon walls. A Defensible Space practice with a fuelbreak along Gross Reservoir Road would lessen the risk from fire starting along the road. Prescribed fire is not recommended in this stand due to steep terrain and risk of escape.

Operations are limited by steep terrain. The stand is accessible from above and from Gross Reservoir Road. Much of it could be thinned for fuelwood. Skidding distances in the eastern half would be limited to the reach of a cable. Soils are Ferncliff series and present no special problems.

Vehicle access is via Gross Reservoir Road in the west and from the canyon rim (Stand B) in the east. Two hiking trails (South Boulder Creek and Crescent Meadow) pass through the stand, but are too narrow for vehicles.

A small, intermittent creek rises in the western end of this stand. There is no wetland vegetation associated with it. There are no riparian zones or wetland features.

There are no silvicultural objectives for this stand. It is to be protected for its scenic qualities, with the possible exception of a Defensible Space practice along Gross Reservoir Road. There is no insect or disease problem that requires cutting.

No cultural features were observed in this stand.

No noxious weeds were observed (This stand is heavily-stocked; there is little opportunity for "weeds" to compete with existing trees. Also, see comments on page 21.).

Woodpecker nesting holes were observed.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21, above.).

The only portions of this stand visible to the public are that portion bordering Gross Reservoir Road and the hiking trails. People do not make use of this stand, for the most part. Most of it faces steep, difficult-access terrain where few people can see it.

There are no known archeological sites within this stand.

Stand B: This is a ponderosa pine, large pole stand. It contains a few Douglas-firs and Rocky Mountain junipers, but not enough to include in the type description. Sawtimber stocking totals about 2500 board feet per acre, on average. The stand averages 60 square feet of basal area per acre, or about 173 trees. The stand originated about 1890, apparently following a fire.

The stand is medium stocked due mainly to mountain pine beetles, which very effectively thinned it. In addition, there was cutting in the mid-1970s. The stand is in good condition and does not require treatment at this time. There are several dwarf-mistletoe infections that should be monitored, but action is not required at this time.

A road/hiking trail provides access to the west end. In addition, trails through Stand D provide access to the east end. Terrain, although not flat, is much better than in Stand A. With careful choice of routes, most of it is accessible. Relatively flat terrain and acceptable access allow fires to be fought with trucks.

Commercial harvesting of firewood is feasible, but not needed. Trails must be water-barred to prevent erosion.

There are no riparian areas or wetlands.

The only silvicultural objective for this stand at this time is to give it time to grow. No cutting or other activities are anticipated during the ten-year life of this plan.

No cultural features were observed in this stand.

No noxious weeds, other than a few scattered thistles, were observed. Dry conditions and poor, rocky soils will keep most weeds in check.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.). Most of this stand is never seen by park visitors, except for the strip along Crescent Meadow Trail. From a distance, it is visible only from the air.

There are no known archeological sites within this stand.

Stand C: This is a Douglas-fir, large pole stand. It contains a few ponderosa pines, but not enough to include in the type description. Sawtimber stocking totals about 1400 board feet per acre, on average. The stand averages 123 square feet of basal area per acre, or about 244 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the budworm epidemic and still shows the damage. There are many dead trees. Ponderosa pines are too sparse to support a significant dwarf-mistletoe infection.

Aside from lightning, there is no ignition source even close to this stand. Dead trees will spread firebrands if the site ever burns, but without people, there is little chance that will happen.

Operations are limited by steep terrain. The stand is accessible from above through Stand D. Skidding distances are limited to the reach of a cable. Soils are Ferncliff series and present no special problems.

Vehicle access is via the ridge through Stand D. Movement on-site is difficult due to steepness.

A small, intermittent creek forms the northern boundary of the stand. There is no wetland vegetation associated with it. There are no riparian zones or wetland features in this stand.

The silvicultural objective is to give this stand time to grow and to protect it for its scenic qualities. There is no insect or disease problem that requires cutting.

No cultural features were observed in this stand.

No noxious weeds were observed.

Woodpecker nesting holes were observed.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed. This stand is completely isolated and cannot be seen from any established road or trail.

There are no known archeological sites within this stand.

Stand D: This is a ponderosa pine, large pole stand. It contains a few scattered Douglas-firs and an included patch of Douglas-fir less than three acres in area, but not enough to include in the type description. Sawtimber stocking totals about 1600 board feet per acre, on average. The stand averages 66 square feet of basal area per acre, or about 183 trees. The stand originated about 1890, apparently following a fire.

Though the soil series is Juget, there appear to be numerous inclusions that make this stand better than would normally be anticipated on such a soil. The medium stocking is due to mountain pine beetles, which effectively thinned it. In addition, there was cutting in this stand in the mid-1970s. The stand is in good condition and requires no treatment. There are several dwarf-mistletoe infections that should be monitored, but action is not required at this time.

A road/hiking trail provides access to the west end. It is readily accessible to vehicles via the trail. Terrain is relatively flat. Fires can be fought with trucks.

Commercial harvesting of firewood is feasible, but not needed. Some trails will need to be water-barred to prevent erosion.

The southern edge of this stand is a creek. A narrow riparian zone borders it. There is considerable variety of plant life here and the riparian area should be protected from disturbance if and when cutting activities ever occur. Though no rare species were observed during field work, this would be a good place to look for them.

The only silvicultural objective is to give the stand time to grow. No cutting or other activities are anticipated during the ten-year life of this plan.

No cultural features were observed in this stand.

No noxious weeds, other than a few scattered thistles, were

observed.

Woodpecker nesting holes were observed.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed.

Most of this stand is never seen by park visitors, except for the western end. A buffer zone around the meadow would be desirable if cutting activity ever occurs here.

There are no known archeological sites within this stand.

Stand E: This is a ponderosa pine, small sawtimber stand with associated Douglas-fir. The species mix is about half pine and half Douglas-fir, with pine predominating near the meadow and Douglas-fir elsewhere. Sawtimber stocking totals about 2400 board feet per acre, on average. The stand averages 65 square feet of basal area per acre, or about 130 trees. The stand originated about 1890, apparently following a fire.

Dwarf-mistletoe is present, but is not a serious problem. This stand should be considered low-priority for dwarf-mistletoe control.

This stand is on the edge of the meadow and has probably burned more often than any other part of the property. It is readily accessible by vehicle or foot.

While commercial harvesting is feasible, at this time there is no need for it. The stand should be given time to grow.

There are no riparian or wetland areas in this stand.

The silvicultural objective is to give this stand time to grow.

No cultural features were observed in this stand.

No noxious weeds were observed.

This site appears to be used by deer for shelter. They make use of the meadow for grazing, staying close to cover. As no cutting is anticipated during the life of this plan, there will be no effect on wildlife.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

This stand contains no nesting sites for bald eagles or peregrine falcons; it is too close to the road and has no cliffs.

No endangered or threatened plant species were observed.

This stand is visible from Gross Reservoir Road and Crescent Meadow. Any activities need to consider visual impacts. As no activities are planned here, there will be no change in scenic or aesthetic qualities of the stand.

There are no known archeological sites within this stand.

Stand F: This is a ponderosa pine, small sawtimber stand with associated Douglas-fir. Sawtimber stocking totals about 1800 board feet per acre, on average. The stand averages 70 square feet of basal area per acre, or about 187 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the budworm epidemic and still shows the damage. There are many dead trees. Ponderosa pines are too sparse to support a significant dwarf-mistletoe infection.

Fire starting in or near the meadow and driven by a southwest wind, would soon reach this stand. If not pushed by a wind, a fire would move slowly, having to burn downhill along much of the front. The stand is accessible to fire-fighting vehicles via an old skid trail through Stands G and D.

Operations are somewhat limited by steep terrain, but the upper slopes (south side) are accessible through Stand G. Skidding distances will be limited to the reach of a cable. Soils are Ferncliff series and present no special problems.

Vehicle access is via the ridge Stands D and G. Movement on-site is difficult due to steepness.

A small, intermittent creek forms the northern boundary of the stand (See Stand D, page 30, for a description of the riparian zone.).

The silvicultural objective is to give this stand time to grow and to protect the riparian zone. There is no insect or disease problem that requires cutting.

The only "cultural features" are several small collapsed buildings, apparently root cellars, along the creek near the west end of the stand.

Woodpecker nesting holes were observed. The stand contained numerous deer trails. Apparently, the creek is a well-used water source.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21, above.).

There are no potential falcon nesting sites and only a few trees that might interest an eagle. The stand is within the hunting territory of a falcon nest near Twin Sisters.

No endangered or threatened plant species were observed (See description in Stand D, page 30.).

This stand is almost completely isolated; only the west end can be seen from the meadow.

There are no known archeological sites within this stand.

Stand G: This is a ponderosa pine, large pole stand. Saw-timber stocking totals about 800 board feet per acre, on average. The stand averages 48 square feet of basal area per acre, or about 150 trees. The stand originated about 1890, apparently following a fire.

The stand is medium stocked due mainly to thinning done to forestall mountain pine beetles. It is in good condition and does not require treatment. There are several dwarf-mistletoe infections that should be monitored, but action is not needed at this time.

An old road provides access to the south end of this stand, which is also accessible from the meadow. The terrain is relatively flat and vehicles can go most places in it. Flat terrain and acceptable access allow fires to be fought with trucks.

Commercial harvesting of firewood is feasible, but not needed. Skid trails must be water-barred to prevent erosion.

There are no riparian areas or wetlands in this stand.

The only silvicultural objective for this stand at this time is to give it time to grow. No cutting or other activities are anticipated during the ten-year life of this plan.

No cultural features were observed in this stand.

No wildlife was observed during field work.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21, above.).

Most of this stand is never seen by park visitors. A small part can be seen from the railroad right-of-way (Where Amtrak trains pass.). Most is screened by other stands.

There are no known archeological sites within this stand.

Stand H: This is a ponderosa pine, small sawtimber stand with associated Douglas-fir. Sawtimber stocking totals about 1700 board feet per acre, on average. The stand averages 73 square feet of basal area per acre, or about 193 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the mountain pine beetle epidemic, which created sizeable openings. These are now being taken over by Douglas-fir. Most of the dead trees are nearly gone. There are a few trees with dwarf-mistletoe.

Fire starting in the meadow would readily spread to this stand. The old road through it could be used as a fire line, as well as providing access.

This stand was thinned in the 1970s and does not need further treatment at this time. Operations would be easy to carry out.

Vehicle access is via the old road.

There are no streams or wetlands.

The silvicultural objective is to give this stand time to grow and to protect it. There is no insect or disease problem that requires cutting.

The old road that provides access to this stand once also provided access to the railroad and to other properties that now have other access. It might be considered a "cultural resource."

No noxious weeds were observed.

Woodpecker nesting holes were observed. The stand contained deer trails.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed.

This stand is readily visible from most of the meadow, Gross Reservoir Road and the railroad right-of-way.

There are no known archeological sites within this stand.

Stand I: This is a ponderosa pine, large pole stand. Sawtimber stocking totals about 900 board feet per acre, on average. The stand averages 35 square feet of basal area per acre, or about 90 trees. The stand originated about 1890, apparently following a fire.

It is lightly stocked due mainly to natural openings that have not been stocked since heavy grazing began, more than 100 years ago. There are several dwarf-mistletoe infections that should be monitored, but action is not needed at this time.

An old road provides access to the south end of this stand. It is also accessible from the meadow. The terrain is relatively flat and vehicles can go most places in it. Flat terrain and acceptable access allow fires to be fought with trucks.

Commercial harvesting of firewood is feasible, and might be used for dwarf-mistletoe control. The trail should be water-barred after use.

There are no riparian areas or wetlands in this stand, but an intermittent stream flows along the west boundary. There are wetland grasses in the adjacent meadow.

The only silvicultural objective for this stand at this time is to give it time to grow, possibly doing some dwarf-mistletoe control work. No other activities are anticipated during the ten-year life of this plan.

No cultural features were observed in this stand.

Deer and elk droppings were observed.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed.

Most of this stand is never seen by park visitors. The south end can be seen from the railroad right-of-way (Where Amtrak trains pass.). Most is screened by other stands.

There are no known archeological sites within this stand.

Stand J: This is a ponderosa pine, small sawtimber stand with associated Douglas-fir. Sawtimber stocking totals about 1600 board feet per acre, on average. The stand averages 68 square feet of basal area per acre, or about 180 trees. It originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the budworm epidemic. A sizable Douglas-fir component was killed out and the space is now being taken over by ponderosa pine. Some dead trees still stand. Ponderosa pines support a modest dwarf-mistletoe infection.

The stand is readily accessible to fire vehicles via the old road. The terrain is relatively flat; movement within the stand is not difficult.

Thinning and salvage of dead Douglas-fir are possible treatments. Terrain can be easily handled.

The silvicultural objective is to give this stand time to grow and to protect it. There is a light dwarf-mistletoe infection that should be monitored.

There are no cultural features in this stand.

Woodpecker nesting holes were observed. Deer use the old road as a trail.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed.

This stand can be seen only from the railroad right-of-way. It is screened from all other directions.

There are no known archeological sites within this stand.

Stand K: This is a Douglas-fir, large pole stand. Sawtimber stocking totals about 1800 board feet per acre, on average. The stand averages 62 square feet of basal area per acre, or about 125 trees. The stand originated about 1890, apparently following the Boulder Canyon Fire.

The stand was attacked during the budworm epidemic; many trees were killed and are still standing. Difficult access has prevented their salvage.

Access is by way of the old road along the railroad. This is for fire emergency only, as the last 100 yards would be on the railroad right-of-way, very close to the track. This stand is so remote that unless the railroad starts a fire, there is not likely to be one, as few people ever visit the site.

Operations are limited by steep terrain. The stand is accessible to a very limited extent from Stand G. Otherwise, there is no feasible access. Soils are of the Ferncliff series and present no special problems.

A small, intermittent creek forms the western stand boundary. The riparian zone is only a few feet wide and entrenched so that if a vehicle ever got into it, it might never get out.

There are no silvicultural objectives for this stand. It is inaccessible to eqipment. There is no insect or disease problem that requires cutting.

No cultural features were observed in this stand.

Woodpecker nesting holes were observed.

The property is located in the Georgetown block on the threatened and endangered species list (See page 21.).

No endangered or threatened plant species were observed.

The stand is visible from the railroad right-of-way. Otherwise, it is completely hidden.

There are no known archeological sites within this stand.

PRESCRIPTION BY MANAGEMENT UNIT

INNER CANYON:

Stand A: Eradicate dwarf-mistletoe. This should be done slowly, at a rate of about 3.0 acres per year, with the entire operation spread over 15 years. Infected ponderosa pines (Ponderosa pine dwarf-mistletoe does not attack Douglas-fir or Rocky Mountain juniper.) should be killed by girdling and left standing for woodpeckers to build nesting cavities in them. Girdled trees will take between a month and four years to die. Standing dead trees serve as raptor perches. Hawks and owls "patrol" the planting (See below.), keeping down rodents which damage or kill new seedlings.

When infected trees have been eliminated from the patch, it should be planted. A three-acre patch should be planted with 1440 ponderosa pine seedlings. To improve survival and growth, each seedling should have a six-foot square of weed barrier placed around it and anchored.

Unfortunately, this brings the three-acre cost to about $9000. This is expensive, but there is no way to reduce it that I know. After one year in the ground, the cost comes to about $7.00-$8.00 per live seedling, regardless of the planting technique used.

Stand B: Let it grow. No action is needed and difficult access makes work costly.

Stand C: Let it grow. Though thinning along the road could benefit the stand and reduce fire hazard, it would be clearly visible. Scenic concerns outweigh stand health.

Stand D: Let it grow. Same as Stand C.

Stand E: Let it grow. No action is needed and access is difficult.

CRESCENT MEADOWS:

Stand A: Reduce fire hazard by thinning a 100-foot-wide strip along Gross Reservoir Road, using Defensible Space standards:

1. Thin so residual crowns do not touch (This can be done commercially - a contractor pays for the wood; there is no cost to the Division of Parks.).

2. Remove "fire ladders (branches, bushes and small trees)" to a height of ten feet so that fire cannot climb from the ground into the tree tops.

3. Chip and/or remove resulting slash and burnable debris.

4. Along the edge of the treated area, away from the road, clear a fire line (A disk behind a tractor is much cheaper than a hand crew.). Renew the fire line during periods of high fire danger (at least once a year).

Stands B, D, E, G, H, I and J: Monitor dwarf-mistletoe infections. This can be done with a simple cruising

technique. A small sample can be taken each year for continuous results, or a larger sample taken at five-year or ten-year intervals. If plots are permanently marked, direct comparisons can be made from one sample to the next.

This can also be done on a one-time-only basis. It is cheaper, but if you ever want to repeat it, sampling error problems have to be overcome; this means a large sample that runs up the cost.

Stand B: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

> Note: Patch cuts (or, in this case, girdling) are used in areas where dwarf-mistletoe control is desirable, but trees do not have sufficient value to justify more-expensive control methods such as intensive pruning. To minimize visual effects, patch cuts are kept small, less than 3.0 acres. After girdled trees have shed their needles, visibility reduced and the patch is restocked, adjoining patches may be cut. Gradually, over many years, the cut patch expands to encompass the entire dwarf-mistletoe patch.

Stand C: Let it grow. The volume of products that should be removed for forest health is too small to pay for the work. Thinning on steep terrain is expensive and, in this case, would require the removal of more trees than is good for the stand.

Stand D: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

Stand E: Let it grow. This stand is worth more to deer as cover than it is worth thinned for wood products.

Stand F: Let it grow. The small amount of product that should be removed for forest health purposes is not worth the disturbance that would be caused in Stand G. A thinning

/salvage operation should be reconsidered in 1998.

Stand G: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

Stand H: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

Stand I: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

Stand J: If indicated by the dwarf-mistletoe monitoring program above, control dwarf-mistletoe using small patch cuts. Otherwise, let it grow; this stand has not yet replaced volume removed in the mid-1970s thinning. This prescription should be reconsidered in 1998 to make sure it still applies.

Stand K: Let it grow. Severe access problems prevent needed thinning work in this stand. Existing snags could well be used as den trees after they begin to decompose.

IMPLEMENTATION SCHEDULE and RECORD

RECOMMENDED PRACTICES, YEAR IMPLEMENTED, UNITS COMPLETED

1994:
1. Eradicate dwarf-mistletoe from 3.0 acres of Inner Canyon Stand A. Do this by girdling and/or injecting with herbicide. Post CSFS wildlife signs on girdled trees to explain the action to the public.
2. Begin dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J.
3. Thin 100-foot strip along Gross Reservoir Road in Crescent Meadows Stand A.

1995:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above.
2. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
3. If indicated by 1994 monitoring program, begin dwarf-mistletoe control in Crescent Meadows.
4. Prune trees in 100-foot strip in Crescent Meadows, Stand A. Chip or otherwise dispose of slash.

1996:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 1996 should be about 9.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1994 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.
5. Install fire line along east side of 100-foot strip in Crescent Meadows, Stand A.

1997:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 1996 should be about 12.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1995 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

1998:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 1997 should be about 15.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1996 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.

   If continuous-monitoring is not being used, conduct 5-year periodic dwarf-mistletoe survey in same stands.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.
5. Revise and update this plan. This is a revision, not a complete re-make of the plan.

1999:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 1999 should be about 18.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1997 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

2000:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 2000 should be about 21.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1998 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

2001:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 2001 should be about 24.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 1999 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

2002:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 2002 should be about 27.0 acres.).
2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 2000 dwarf-mistletoe control. Use weed barrier.
3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

2003:
1. Eradicate dwarf-mistletoe from another 3.0 acres of Inner Canyon Stand A, as above (Total area treated at end of 2003 should be about 30.0 acres.).

2. Plant 1440 large-pot ponderosa pine seedlings in opening in Inner Canyon Stand A created by 2002 dwarf-mistletoe control. Use weed barrier.

3. Continue dwarf-mistletoe monitoring program in Crescent Meadows Stands B, D, E, G, H, I and J, if the continuous-monitoring option is being used.

   If continuous-monitoring is not being used, conduct 5-year periodic dwarf-mistletoe survey in same stands.

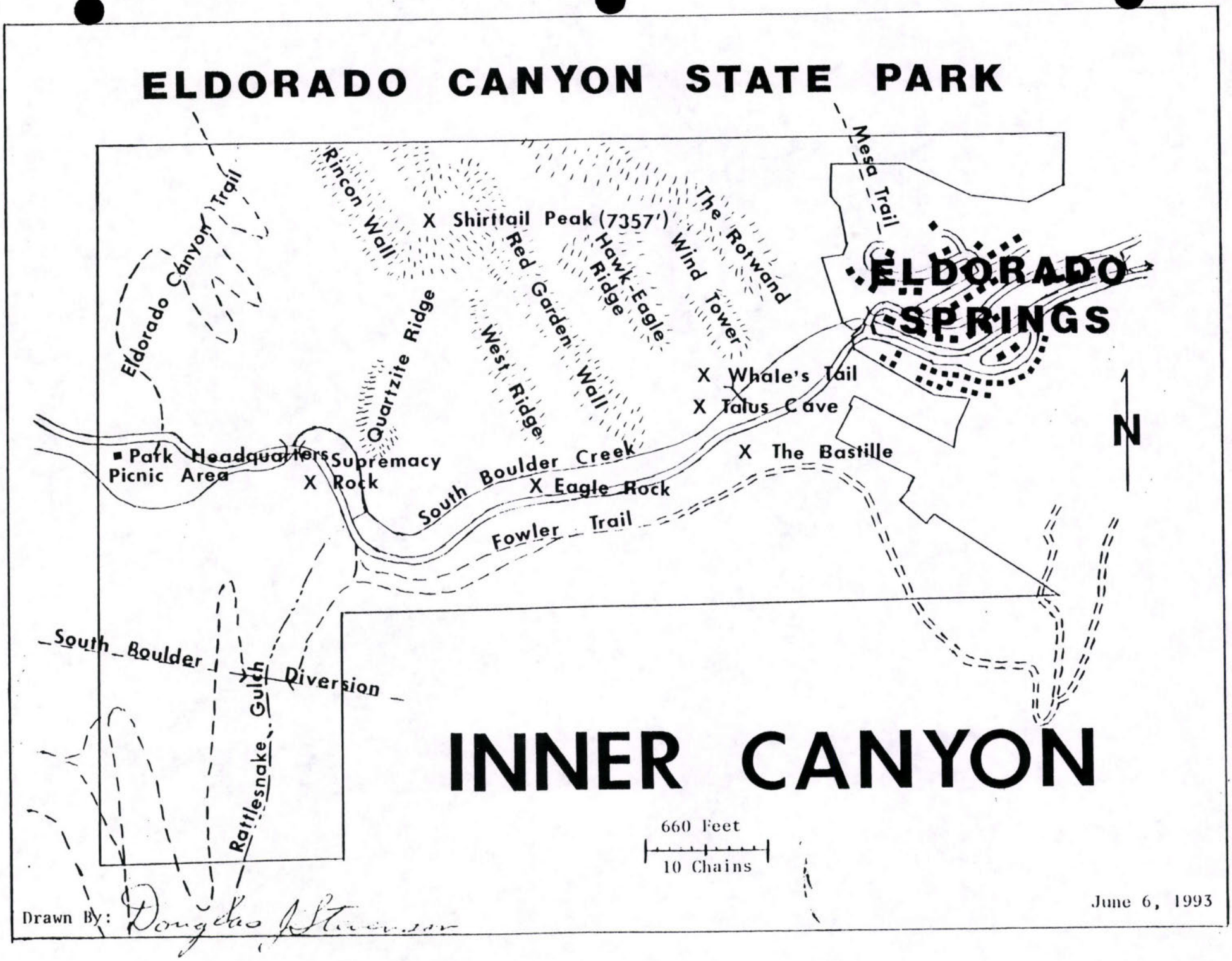
4. Continue dwarf-mistletoe control in Crescent Meadows, if appropriate.

5. Prepare a new plan. Most management plans are not being precisely followed after only two or three years. By ten years, even with revisions, a typical plan is usually quite different from what is actually happening on the ground.

RECORDS and MAPS; TREATMENTS, DATES COMPLETED, VOLUME HARVESTED; PRICE RECEIVED, MANAGEMENT COSTS

The following section is expandable and meant to serve as a log of forest management work being done on Eldorado Canyon State Park.

RECORDS and MAPS; TREATMENTS, DATES COMPLETED, VOLUME HARVESTED; PRICE RECEIVED, MANAGEMENT COSTS (Continued).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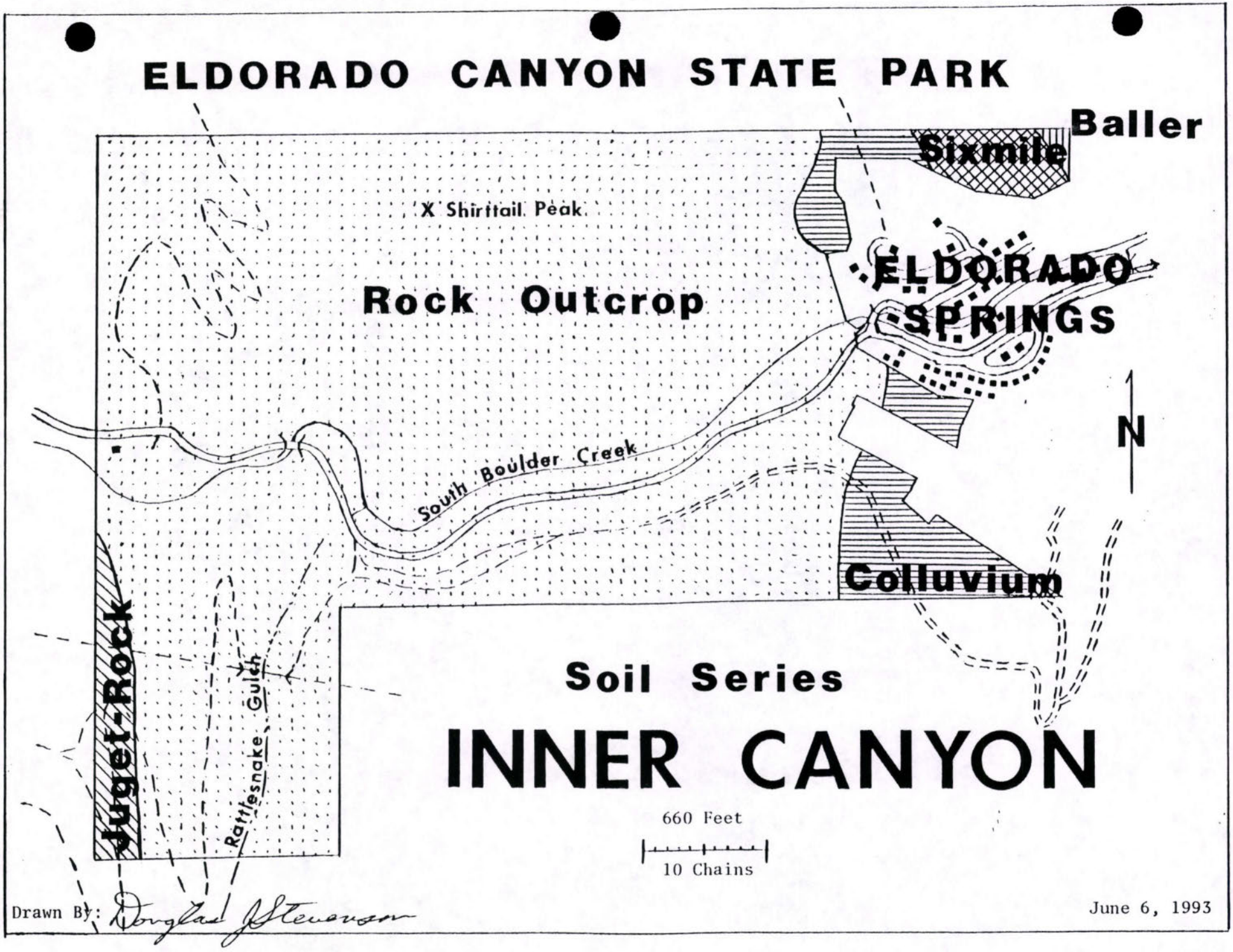
Eldorado Canyon Trail
Rincon Wall
X Shirttail Peak (7357')
Red Garden Wall
Hawk-Eagle Ridge
Wind Tower
The Rotwand
Mesa Trail
ELDORADO SPRINGS
Quartzite Ridge
West Ridge
X Whale's Tail
X Talus Cave
N
Park Headquarters Picnic Area
Supremacy X Rock
South Boulder Creek
X Eagle Rock
X The Bastille
Fowler Trail
South Boulder Diversion
Rattlesnake Gulch
INNER CANYON
660 Feet
10 Chains
Drawn By: Douglas J. Stevenson
June 6, 1993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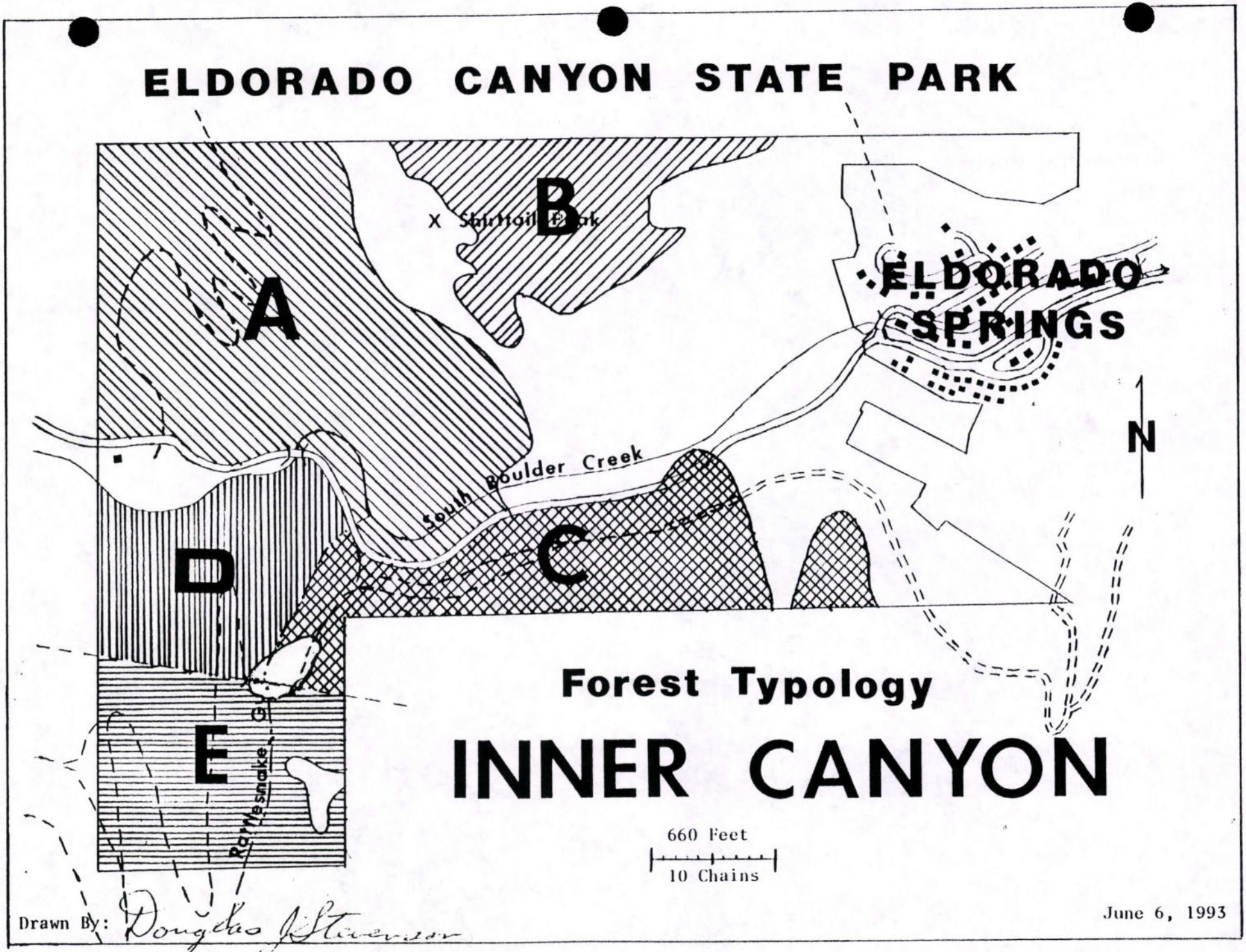
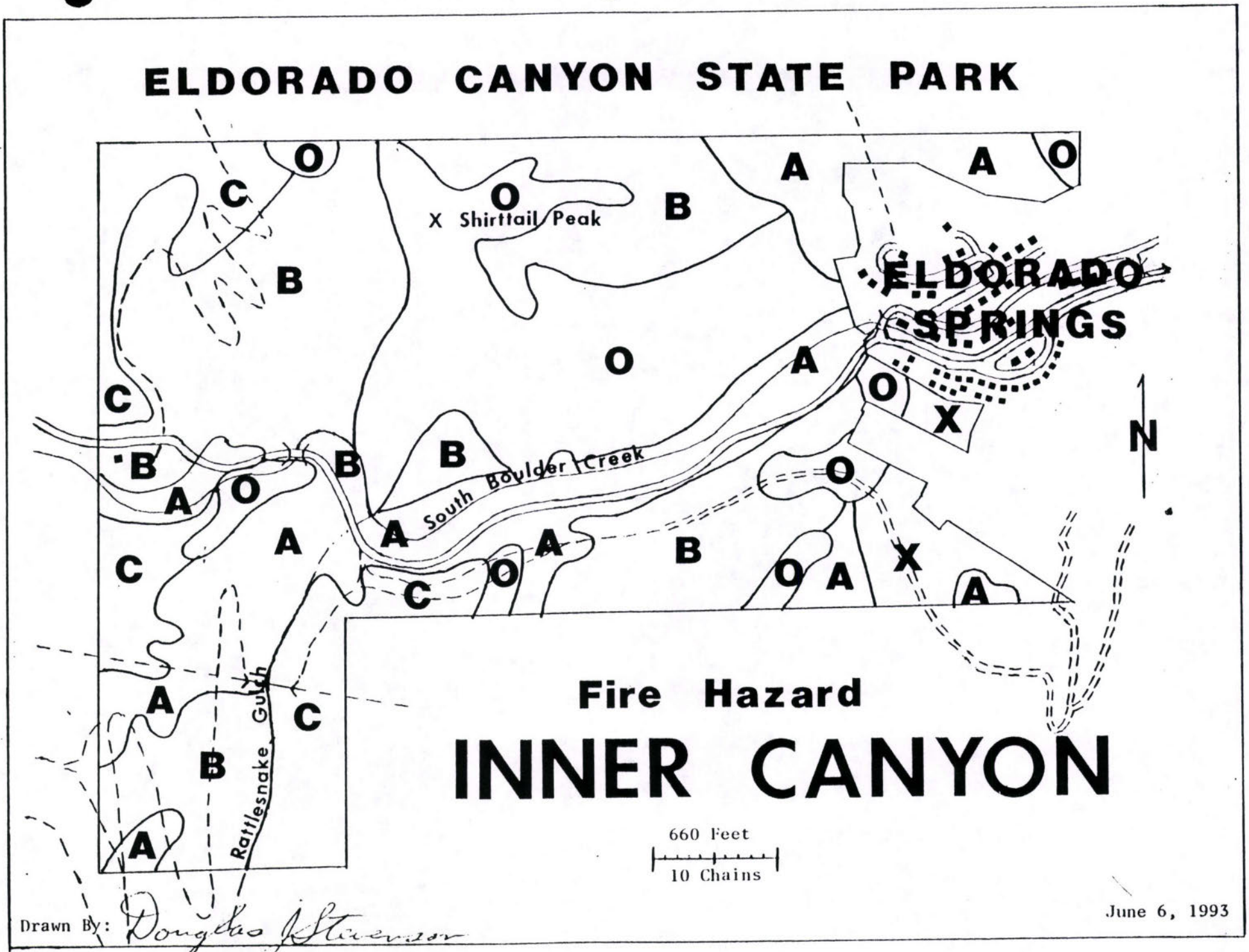
Baller
Sixmile
X Shirttail Peak
Rock Outcrop
ELDORADO SPRINGS
N
South Boulder Creek
Colluvium
Jugget-Rock
Rattlesnake Gulch
Soil Series
INNER CANYON
660 Feet
10 Chains
Drawn By: Douglas J Stevenson
June 6, 1993


ELDORADO CANYON STATE PARK
A
B
C
D
E
X Shirttail Peak
ELDORADO SPRINGS
South Boulder Creek
Rattlesnake Gulch
N
Forest Typology
INNER CANYON
660 Feet
10 Chains
Drawn By: Douglas J. Stevenson
June 6, 1993


ELDORADO CANYON STATE PARK
X Shirttail Peak
ELDORADO SPRINGS
South Boulder Creek
Rattlesnake Gulch
N
Fire Hazard
INNER CANYON
660 Feet
10 Chains
Drawn By: Douglas J. Stevenson
June 6, 1993

FIRE HAZARD

O: No hazard. Rock outcrop, water surface, pavement or other non-burnable surface.

A: Low Hazard. Trees and Grass. Fuel Models 1 and 2. Low slope angle.

B: Medium Hazard. Trees. Fuel Models 2 and 8. Slope angle exceeds 30%.

C: Severe Hazard. Trees. Fuel Models 8 and 10. Slope angle exceeds 30%.

X: Severe Hazard. Brush. Fuel Model 6.

Note: Except for a strip along South Boulder Creek, the Inner Canyon unit consists entirely of slopes of 30%.

FUEL TYPE CODES

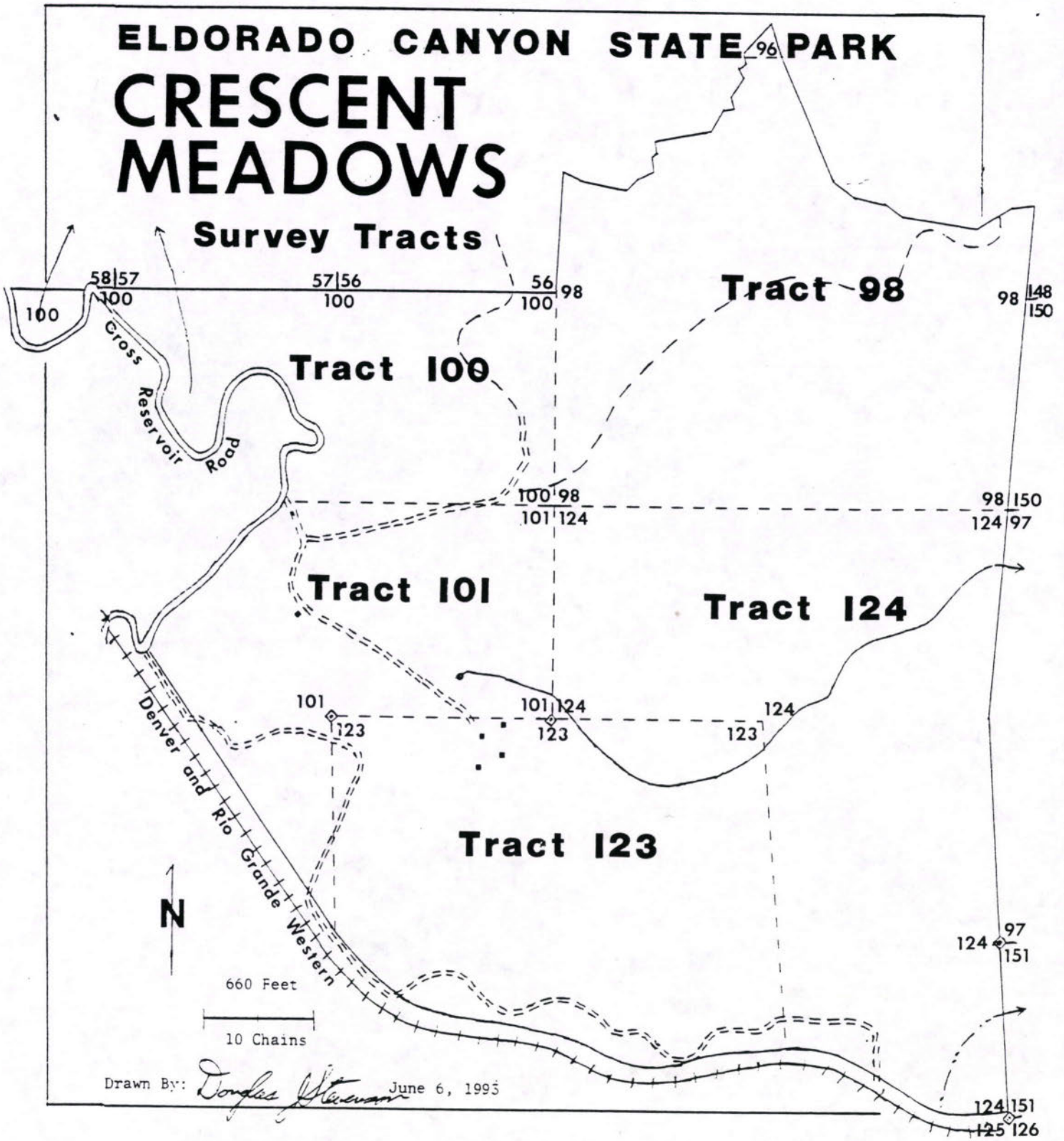
Model 1: Grass has a relatively fine structure, is generally below knee level and is easy to walk through. Surface fires burn very rapidly.

Model 2: Mixture of grass and litter beneath open timber or brush overstory that does not burn. Surface fires spread easily; clumps of fuels generate higher intensities that may spread firebrands.

Model 6: Brush with flammable foliage (spring and fall). Fire carries through brush at moderate wind speeds, but drops to ground at low speeds, or in openings.

Model 8: One-hour and ten-hour total fuel load combined is about equal to 100-hour total fuel load. Foliage litter is short needle coniferous or small hardwood leaves, tightly compacted. Slow burning surface fires with low flame heights; occasional "jackpots" cause flareups.

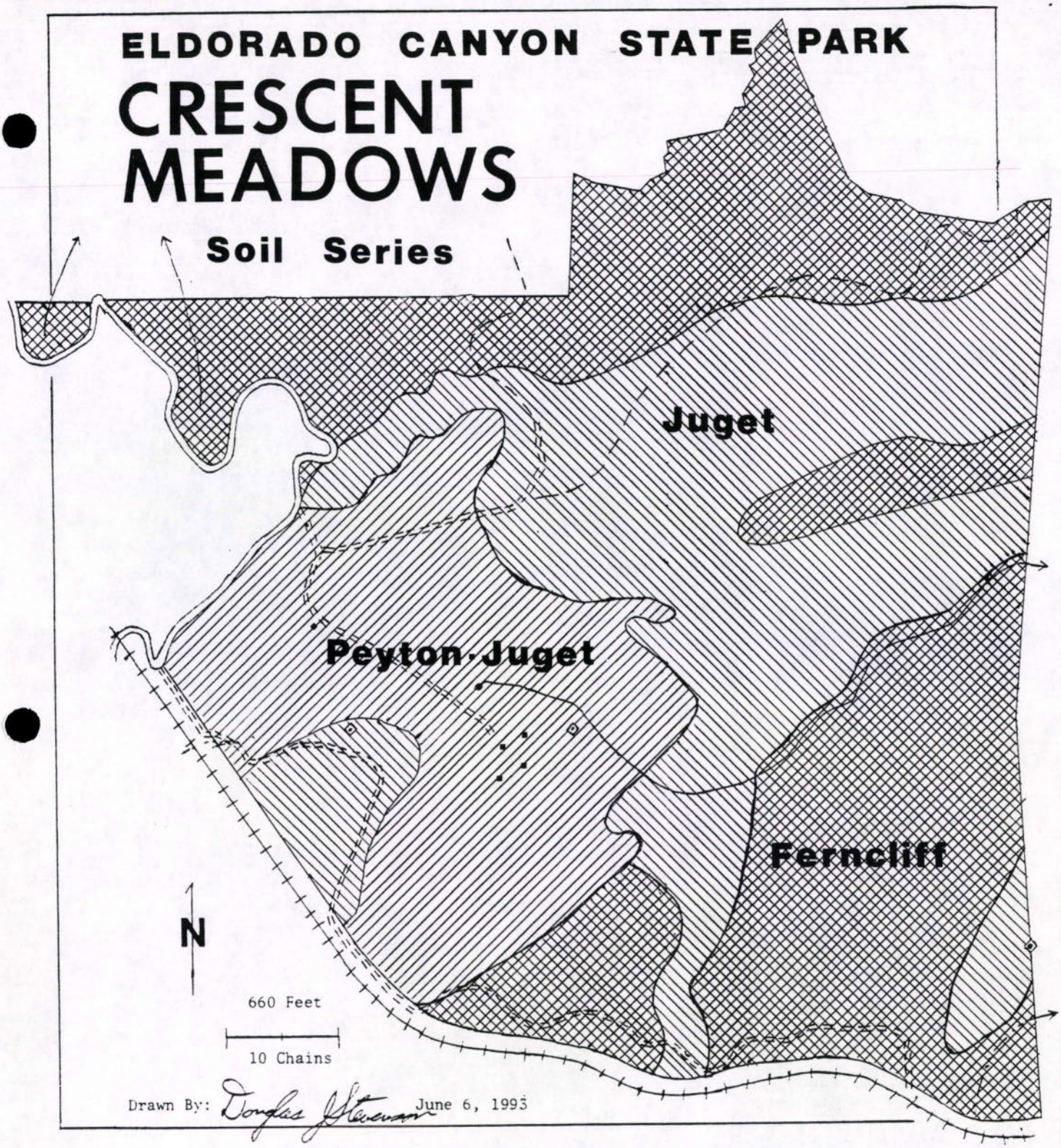
Model 10: High loadings of dead, woody fuels, shrub understory and/or tree reproduction. Torching and high fire intensity burning.


ELDORADO CANYON STATE PARK
CRESCENT MEADOWS
Survey Tracts
Tract 98
Tract 100
Tract 101
Tract 124
Tract 123
Cross Reservoir Road
Denver and Rio Grande Western
N
660 Feet
10 Chains
Drawn By: Douglas Stevenson June 6, 1993

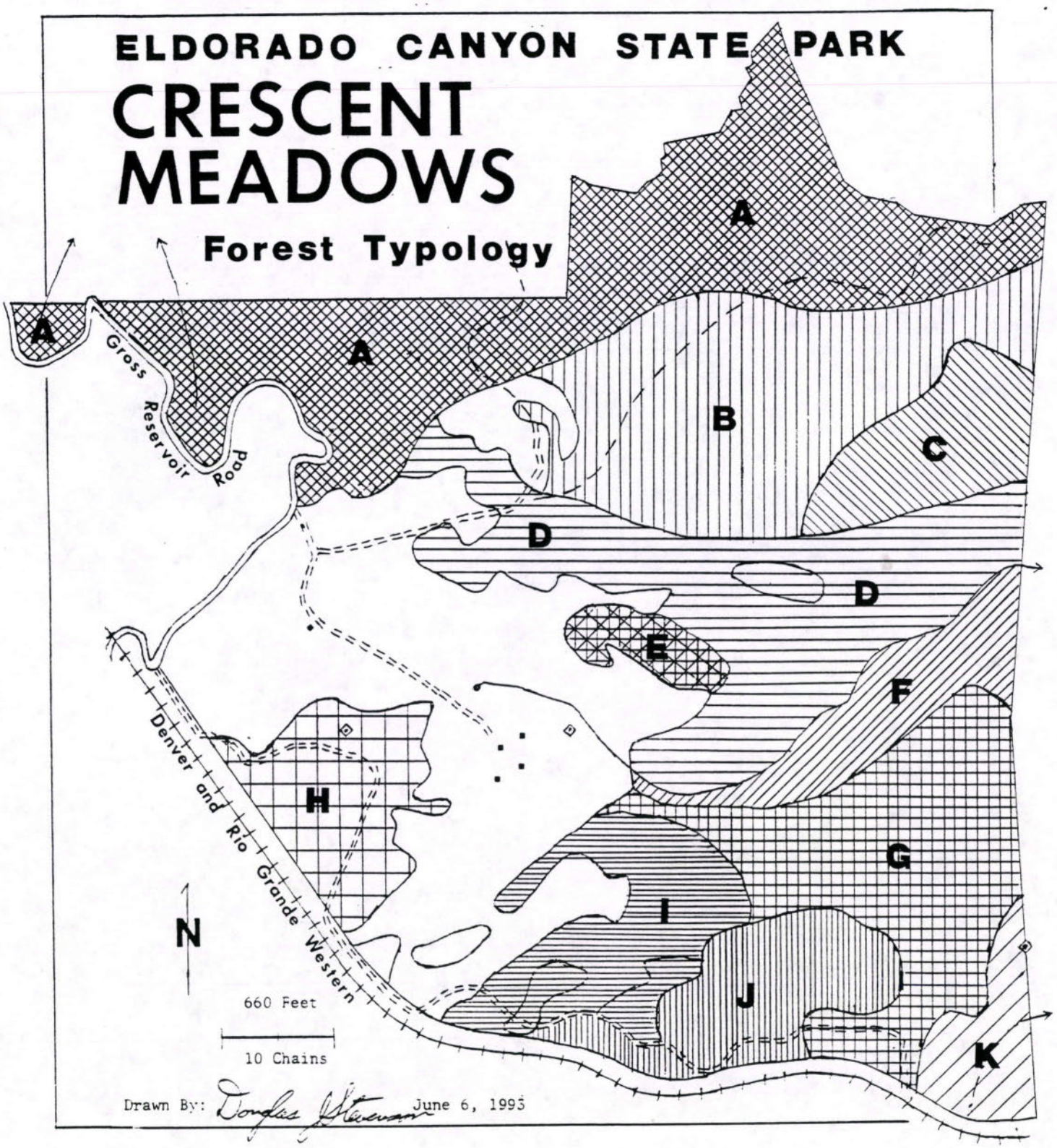
ELDORADO CANYON STATE PARK

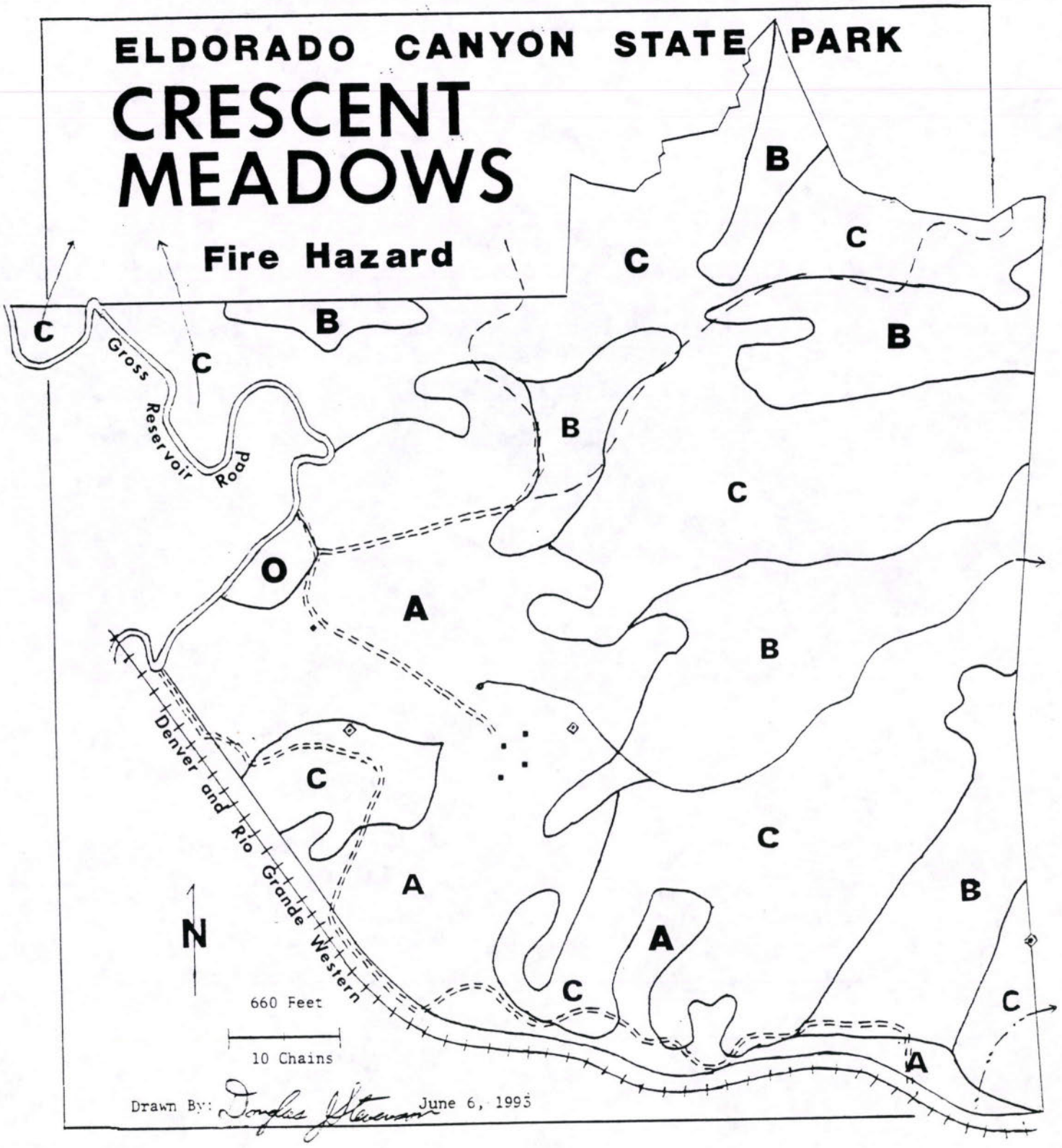
CRESCENT MEADOWS

Soil Series



Drawn By: Douglas J. Stevenson June 6, 1993


ELDORADO CANYON STATE PARK
CRESCENT MEADOWS
Forest Typology
A
A
A
B
C
D
D
E
F
G
H
I
J
K
Gross Reservoir Road
Denver and Rio Grande Western
N
660 Feet
10 Chains
Drawn By: Douglas Stevenson June 6, 1993


ELDORADO CANYON STATE PARK
CRESCENT MEADOWS
Fire Hazard
Gross Reservoir Road
Denver and Rio Grande Western
N
660 Feet
10 Chains
Drawn By: Douglas J. Stevenson June 6, 1995

FIRE HAZARD

O: No hazard. Rock outcrop, water surface, pavement or other non-burnable surface.

A: Low Hazard. Trees and Grass. Fuel Models 1 and 2. Low slope angle.

B: Medium Hazard. Trees. Fuel Models 2 and 8. Slope angle exceeds 30%.

C: Severe Hazard. Trees. Fuel Models 8 and 10. Slope angle exceeds 30%.

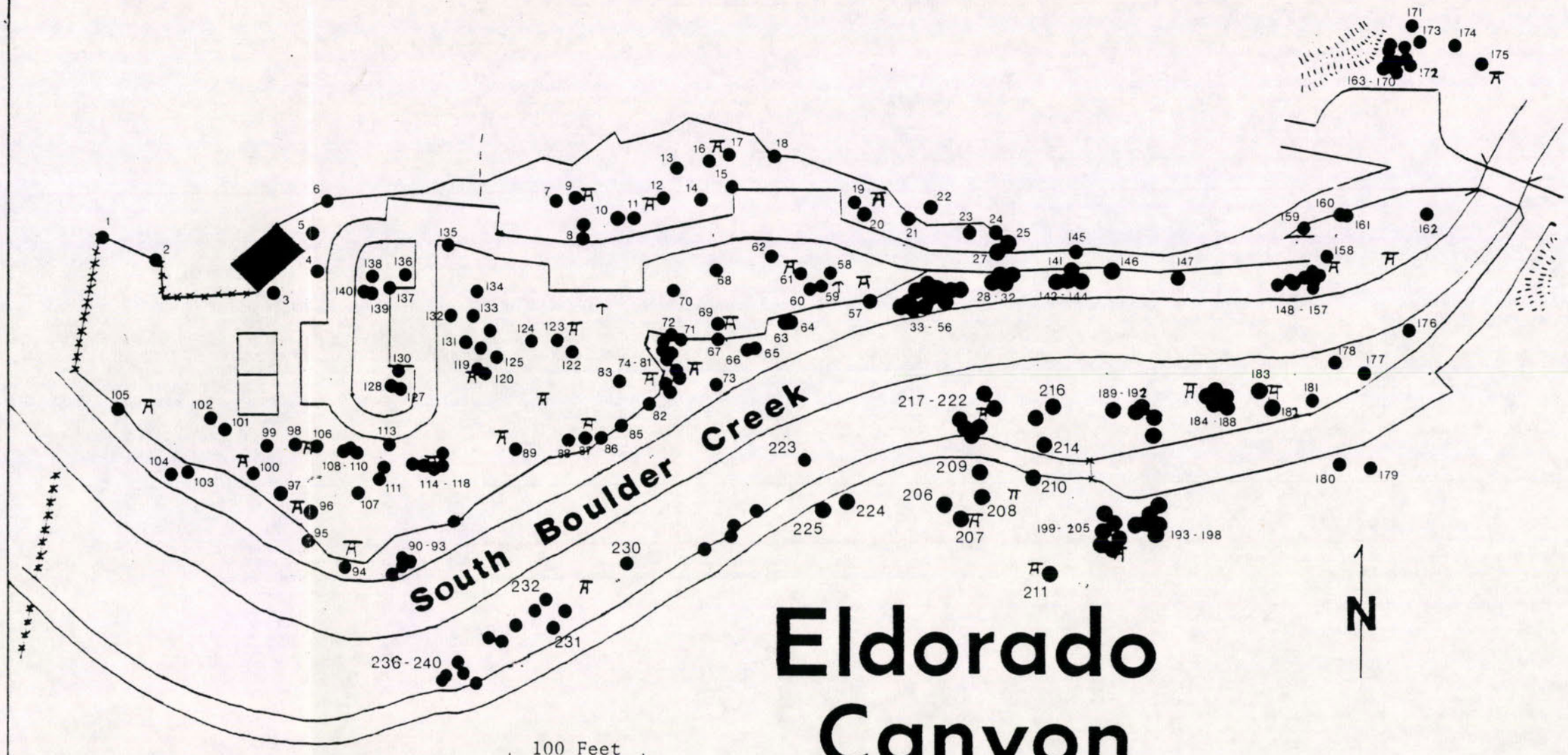
FUEL TYPE CODES

Model 1: Grass has a relatively fine structure, is generally below knee level and is easy to walk through. Surface fires burn very rapidly.

Model 2: Mixture of grass and litter beneath open timber or brush overstory that does not burn. Surface fires spread easily; clumps of fuels generate higher intensities that may spread firebrands.

Model 8: One-hour and ten-hour total fuel load combined is about equal to 100-hour total fuel load. Foliage litter is short needle coniferous or small hardwood leaves, tightly compacted. Slow burning surface fires with low flame heights; occasional "jackpots" cause flareups.

Model 10: High loadings of dead, woody fuels, shrub understory and/or tree reproduction. Torching and high fire intensity burning.



Eldorado Canyon Picnic Area

Drawn By: Douglas J. Stevenson

August 12, 1993

PICNIC AREA TREE LIST

Tree No.	Sp.	Dia.	N-S Pos.	E-W Pos.	Comments
1	DF	16"	0.90	3.10	Numerous wounds; SBW damage.
2	PP	16"	-18.79	43.75	Small wounds; soil disturbance.
3	PP	20"	-40.50	118.82	Root collar compressed by sidewalk, driveway.
4	RMJ	10"	-24.88	162.82	Old pruning wounds.
5	PP	12"	3.26	160.07	Excellent condition.
6	RMJ	12"	27.44	170.71	Uprooted, hazardous; targeted on driveway; remove.
7	PP	10"	28.31	346.35	Serious wounds; broken top; leaning - no targets.
8	DF	18"	9.65	366.49	
9	PP	16"	31.23	358.01	Sound fork; fair condition.
10	DF	14"	12.82	389.52	Decayed butt from bad pruning wound; low vigor; broken fork, crook; targeted on Picnic Table 20; remove.
11	PP	18"	14.08	403.97	Porcupine top; jillpoke.
12	PP	12"	29.86	424.73	Minor crook; dead limbs; prune.
13	PP	16"	52.50	435.27	
14	PP	18"	28.64	452.97	Frost crack - watch; wounds, forks, crooks.
15	DF	16"	37.68	478.05	
16	PP	12"	60.06	459.37	Double tree; root wounds in contact with soil; one trunk leaning - no targets; prune before Public Service does.
17	PP	14"	62.91	471.21	Minor wounds, crook; prune before Public Service does.
18	RMJ	8"	71.36	508.32	
19	DF	16"	27.73	567.36	Butt swell - decay (?).
20	CP	6"	18.45	574.10	(Pyrus communis) common pear; quadruple trunk; needs pruning.
21	RMJ	14"	16.29	606.17	Excellent condition.
22	DF	18"	24.36	622.04	Large butt scar - decay (?); watch.
23	NLC	10"	4.92	653.27	Triple tree.
24	RMJ	12"	-4.27	681.42	
25	RMJ	10"	5.12	675.08	Large pruning wound, sound.
26	MM	2"	-9.02	674.37	Twelve stems.
27	DF	18"	-10.61	672.03	Large butt wound in contact with soil; butt currently sound - safe for now, but will eventually have to be removed; watch.

28	PP	14"	-21.79	686.42	Massive butt wound in contact with soil; small decay pocket - safe for now, but will eventually have to be removed; watch.
29	NLC	10"	-27.45	686.62	Exposed roots; leaning toward creek; no target.
30	NLC	12"	-29.67	683.24	Exposed roots; leaning toward creek; no target.
31	RMJ	4"	-26.31	683.01	
32	RMJ	8"	-31.17	671.34	Exposed roots; leaning toward creek; no target.
33	NLC	4"	-32.19	622.31	
34	NLC	10"	-35.63	641.19	
35	NLC	4"	-35.63	641.19	
36	NLC	4"	-35.63	641.19	
37	NLC	4"	-38.39	649.22	
38	NLC	4"	-38.39	649.22	
39	NLC	4"	-37.94	646.38	
40	NLC	4"	-37.94	646.38	
41	NLC	4"	-37.94	646.38	
42	NLC	5"	-36.75	634.48	
43	NLC	4"	-38.46	636.76	
44	NLC	2"	-35.23	628.69	
45	NLC	2"	-44.98	639.00	
46	NLC	4"	-44.98	639.00	
47	NLC	4"	-48.34	635.46	Triple tree.
48	NLC	3"	-37.64	626.10	
49	NLC	2"	-44.32	625.29	
50	NLC	2"	-50.91	619.76	
51	NLC	5"	-50.86	618.18	
52	NLC	4"	-50.49	615.44	
53	NLC	5"	-52.76	612.73	
54	NLC	4"	-47.26	607.42	
55	NLC	4"	-49.95	601.55	
56	NLC	4"	-36.93	612.48	
57	PP	24"	-47.22	579.30	Bare roots; leaning toward creek - no targets.
58	DF	9"	-26.83	549.70	Excellent condition.
59	DF	10"	-38.43	532.18	Decayed butt with insect galleries; watch.
60	DF	12"	-35.41	531.45	Stem canker; resinosus; watch.
61	DF	14"	-27.43	528.09	Leaning toward Table 17; sound roots; watch.
62	PP	16"	-13.39	505.04	Forked.
63	BE	4"	-73.41	516.52	Excellent condition.
64	BE	4"	-74.30	519.26	Excellent condition.
65	PP	10"	-85.32	491.97	Stabilized frost crack.
66	PP	18"	-85.20	487.69	
67	DF	10"	-77.42	466.44	
68	PP	16"	-23.73	462.69	Forked.
69	DF	12"	-66.23	464.67	

70	PP	18"	-40.13	431.67	
71	DF	14"	-75.25	429.91	
72	DF	10"	-77.73	438.04	Slight lean; butt swell; watch.
73	SC	4"	-111.30	465.96	(Prunus avium) sweet cherry; excellent condition.
74	PP	16"	-85.44	424.14	Excellent condition.
75	BE	4"	-76.98	423.39	Excellent condition.
76	DF	8"	-89.20	429.98	Excellent condition.
77	NLC	12"	-90.49	429.40	Slime flux; crook; weak structure; watch.
78	NLC	4"	-91.79	428.83	
79	BE	5"	-99.25	433.86	Double tree.
80	BE	2"	-107.06	437.38	Eight stems, all small.
81	BE	3"	-116.04	429.48	Excellent condition.
82	BE	3"	-110.54	428.11	Triple tree; needs pruning.
83	DF	12"	-108.35	392.54	
84	PP	12"	-125.68	415.42	Double tree.
85	DF	12"	-143.00	393.99	
86	PP	10"	-150.57	379.25	Bark compressed by rock.
87	PP	18"	-152.59	365.74	Excellent condition.
88	PP	10"	-152.96	353.78	Bad wound; watch.
89	DF	18"	-158.55	314.14	Excellent condition.
90	NLC	4"	-243.05	227.88	Double tree.
91	NLC	4"	-245.00	231.42	
92	NLC	5"	-248.69	228.58	
93	NLC	6"	-254.42	220.70	Double tree.
94	PP	8"	-249.70	185.56	Excellent condition.
95	PP	12"	-230.77	155.44	Excellent condition.
96	NLC	12"	-208.74	158.16	Decayed butt; remove.
97	NLC	12"	-193.52	136.25	Decayed butt; remove.
98	DF	18"	-155.54	143.49	
99	DF	16"	-157.53	126.47	Frost crack; watch.
100	PP	24"	-177.21	114.13	Small wound.
101	DF	26"	-144.12	93.95	Butt swell; wound in contact with soil; watch.
102	DF	24"	-136.47	82.75	
103	PC	6"	-179.08	62.47	(Populus deltoides var. occidentalis) plains cottonwood.
104	NLC	4"	-180.43	53.88	Triple tree; needs pruning.
105	NLC	14"	-129.19	14.12	Broken top; weight toward creek; watch.
106	DF	14"	-169.09	157.47	Large wound; no decay.
107	DF	14"	-192.71	193.72	Stem canker; resinosus; watch.
108	DF	16"	-159.59	186.07	
109	DF	16"	-161.85	189.38	
110	PP	12"	-161.63	191.55	Broken top; weight toward drive; roots sound; watch.
111	PP	14"	-185.53	209.12	Leaning southwest toward table; roots sound; watch.
112	PP	16"	-181.25	212.84	
113	DF	16"	-157.65	217.70	

114	DF	16"	-180.56	232.66	
115	DF	12"	-172.13	243.95	Fair condition.
116	DF	16"	-187.20	248.30	
117	DF	10"	-171.68	257.21	Leaning; canker; frost crack; watch.
118	DF	14"	-179.44	251.76	Fair condition.
119	DF	12"	-102.29	287.13	
120	DF	16"	-102.83	289.91	
121	DF	18"	-98.88	291.65	Broken roots in contact with soil; watch.
122	DF	10"	-87.57	356.40	
123	DF	12"	-77.04	346.92	
124	DF	8"	-78.98	326.45	In choke cherry thicket.
125	DF	8"	-82.31	287.55	
126	DF	16"	-99.68	286.02	
127	DF	14"	-117.37	226.66	Forked with infected seam; still sound, but dangerous; no target; watch.
128	DF	12"	-113.64	226.54	
129	DF	12"	-111.68	220.34	Minor wound.
130	PP	14"	-100.63	223.71	
131	PP	16"	-78.04	287.05	Excellent condition.
132	PP	16"	-58.42	275.72	Sound fork.
133	DF	14"	-58.57	281.77	Butt swell, decay (?); watch.
134	DF	16"	-39.73	284.62	
135	PP	18"	-6.01	261.77	
136	RMJ	8"	-26.94	243.12	
137	PP	24"	-35.26	231.66	Excellent condition.
138	PP	8"	-27.75	219.65	
139	DF	14"	-42.40	202.74	Leaning; roots sound.
140	PP	8"	-41.99	200.41	Leaning; roots sound.
141	PP	16"	-21.08	733.41	Large wound in contact with soil; safe for now, but will eventually have to be removed.
142	DF	8"	-28.59	721.40	Double tree; leaning toward creek; no targets; watch.
143	PP	14"	-29.37	725.68	Minor fork, sound.
144	PP	14"	-28.29	737.91	Crook; leaning toward creek; no target.
145	PP	18"	-9.78	732.62	Fork; protect from vehicles.
146	RMJ	4"	-24.20	760.56	Triple tree.
147	PP	16"	-29.15	809.69	Triple tree.
148	NLC	6"	-33.19	886.46	Double tree.
149	NLC	5"	-28.25	894.62	
150	NLC	4"	-31.42	899.32	
151	PP	12"	-24.05	915.67	
152	BE	4"	-26.87	915.42	
153	PP	4"	-32.30	913.36	
154	PP	6"	-34.56	911.43	
155	PP	10"	-27.46	911.15	
156	PP	6"	-26.02	904.51	
157	PP	5"	-23.46	912.90	

158	PP	16"	-11.11	921.43	Damaged roots; watch.
159	DF	18"	9.82	903.14	
160	DF	14"	19.77	931.26	Root damage; safe for now, but will eventually have to be removed.
161	PP	24"	19.69	934.58	
162	PP	16"	21.45	996.69	Forked, sound.
163	PP	16"	129.50	961.99	
164	DF	12"	138.28	967.32	
165	DF	12"	141.14	967.07	
166	DF	14"	147.03	967.43	
167	PP	14"	136.20	971.55	
168	PP	14"	127.79	972.93	
169	PP	16"	147.14	979.82	
170	PP	14"	138.50	979.65	
171	DF	14"	163.34	985.39	
172	PP	12"	131.77	981.98	Wounds; broken top.
173	DF	14"	149.89	990.05	
174	DF	14"	150.08	1017.32	
175	PP	8"	135.82	1038.46	
176	PP	10"	-68.00	982.69	
177	NLC	18"	-100.64	950.44	
178	NLC	10"	-90.91	929.81	Damaged roots; leaning toward creek; no target; watch.
179	PP	18"	-172.69	956.39	Excellent condition.
180	PP	16"	-169.08	932.35	Minor wounds.
181	NLC	5"	-121.38	912.44	Double tree.
182	NLC	6"	-123.91	883.64	
183	NLC	12"	-110.16	872.41	Forked; decayed butt; remove.
184	PP	14"	-118.01	848.51	Excellent condition.
185	BE	5"	-124.24	848.45	Triple tree.
186	NLC	14"	-119.81	838.02	Snag-top; decay pockets; remove.
187	NLC	10"	-113.44	838.04	Snag-top; decay pockets; remove.
188	DF	12"	-117.16	833.81	Exposed roots.
189	NLC	16"	-124.93	784.70	Decayed butt; remove.
190	DF	5"	-133.31	792.39	Excellent condition.
191	CA	7"	-126.37	783.42	(Malus pumila) common apple; seven stems; needs pruning.
192	PP	24"	-144.91	792.48	Triple tree.
193	DF	14"	-198.35	785.65	Double tree.
194	DF	18"	-217.57	797.66	Leaning - sound.
195	DF	16"	-221.99	795.20	Excellent condition.
196	DF	14"	-209.00	789.53	Stem canker - resinosus.
197	PP	16"	-212.44	787.13	Excellent condition.
198	DF	12"	-211.29	779.89	
199	DF	12"	-230.43	762.34	Fair condition.
200	DF	14"	-224.22	768.14	Fair condition.
201	DF	8"	-213.44	762.93	Stem canker - resinosus.
202	DF	12"	-208.11	758.40	
203	DF	12"	-208.11	758.40	

204	DF	12"	-218.42	754.83	Wounds; decayed butt; watch.
205	DF	16"	-228.37	754.09	Stem canker - resinosus.
206	DF	8"	-232.32	708.94	Butt swell; stem canker - resinosus.
207	DF	16"	-250.95	715.72	Wounds.
208	DF	18"	-209.64	648.47	Stem canker - resinosus.
209	DF	16"	-198.86	637.06	Double tree; fair condition.
210	DF	12"	-173.75	662.98	Double tree; fair condition.
211	PP	14"	-191.75	665.44	Severe wounds - no target; watch.
212	DF	16"	-179.16	700.52	
213	DF	10"	-178.63	705.19	
214	NLC	16"	-126.68	762.60	Wounds; fair condition.
215	NLC	16"	-127.40	718.63	Slime flux; leaning toward creek - no tragets.
216	PP	26"	-152.14	712.46	
217	PP	10"	-142.45	662.04	
218	PP	12"	-144.10	659.50	
219	NLC	18"	-126.04	673.23	Old; poor condition.
220	NLC	18"	-116.82	667.65	Leaning toward creek - no target.
221	NLC	8"	-140.75	654.38	Dead branches - prune; fair condition.
222	NLC	8"	-136.23	650.37	Broken top.
223	NLC	8"	-168.67	530.18	Double tree.
224	NLC	12"	-198.79	561.37	Double tree.
225	NLC	14"	-201.71	546.40	Decayed butt - remove.
226	DF	14"	-209.77	501.56	Wounds; fair condition.
227	NLC	12"	-205.37	494.19	Double tree; prune large dead branch.
228	DF	16"	-220.28	484.74	
229	PP	12"	-247.86	397.49	Excellent condition.
230	BE	10"	-282.02	350.96	Quintuple tree.
231	NLC	8"	-282.57	330.20	Poor condition; dead limbs - no targets; leave.
232	NLC	6"	-274.83	337.72	Dead - remove.
233	NLC	6"	-292.59	314.56	
234	NLC	6"	-294.49	313.51	Triple tree.
235	NLC	10"	-303.90	296.20	
236	PP	20"	-317.51	315.44	Butt wound; root wounds in contact with soil; watch.
237	NLC	6"	-302.68	304.52	
238	RMJ	6"	-335.11	260.19	
239	RMJ	6"	-332.88	261.94	
240	DF	4"	-321.72	270.66	Excellent condition.

Ten species of trees make up the entire stand in the picnic area (See map on page 56A.):

Ponderosa pine, Pinus ponderosa Laws., abbreviated "PP" on the table, consists of 69 trees, making up 28.8% of the stand.

Narrow-leaved cottonwood, Populus angustifolia James, abbreviated "NLC" on the table, consists of 64 trees, making up 26.7% of the stand.

Rocky Mountain Douglas-fir, Pseudotsuga menziesii var. glauca (Beissn.) Franco, abbreviated "DF" on the table, consists of 55 trees, making up 22.9% of the stand.

Rocky Mountain juniper, Juniperus scopulorum Sarg., abbreviated "RMJ" on the table, consists of 12 trees, making up 5.0% of the stand.

Box-elder, Acer negundo L., abbreviated "BE" on the table, consists of 10 trees, making up 4.2% of the stand.

Mountain maple, Acer spicatum Lam., abbreviated "MM" on the table, consists of a single tree and a bush.

Plains cottonwood, Populus deltoides var. occidentalis Rydb., abbreviated "PC" on the table, consists of a single tree that probably resulted from seed blown in from natural stands several miles to the east. This species does not like the mountains and does not do well there.

Common apple, Malus pumila Mill., abbreviated "CA" on the table, consists of a single multi-stemmed tree on the south side of South Boulder Creek. This species has been naturalized to the Ponderosa pine/Douglas-fir zone. This tree is probably an escape from somebody's lunch. It is badly in need of pruning.

Sweet cherry, Prunus avium (L.) L., abbreviated "SC" on the table, consists of a single, vigorous tree growing almost in the creek. It, too, is probably an escape from a lunch-box. Sweet cherry blossoms usually freeze and cannot produce seed in this zone.

Common pear, Pyrus communis L., abbreviated "CP" on the table, consists of a single, multi-stemmed tree. It, like other fruit trees listed above, probably resulted from a carelessly-tossed seed. This tree needs pruning.

In the 1950s many trees in the picnic area sustained heavy damage from axes and knives. Most of this appears to be simple vandalism, but there were also several poor pruning jobs that did more harm than good.

Fungal infections in the wounds subsequently produced serious problems for many trees. Douglas-fir contracted bark cankers that either killed the tree, or left its structural integrity intact. Infected Douglas-fir can generally be left until it dies without serious risk to public safety.

For the most-part, ponderosa pines sealed the wounds and were not seriously harmed; a few trees were infected by decay-causing fungi that created serious weaknesses in the tree's structure. These trees should be removed.

Cottonwoods do not respond well to fungal attack. They are hollowed out by attacking fungi and later collapse. There are several dangerous cottonwoods.

There are also a number of trees that have been uprooted. These should be removed.

There are a large number of trees that would be dangerous if they were leaning or weighted toward a target (a picnic table, parking area, etc. that causes people and vehicles to collect near a dangerous tree). Many of these are aimed at empty lawn or lean toward the creek where they are less likely to cause harm if they fail. These should be watched and removed if their status changes.

Trees that should be removed to prevent their collapse on people or property are numbers 6, 10, 96, 97, 183, 186, 187, 189, 225 and 232.

In addition, several trees need pruning to keep them healthy and prevent future problems. This should be done by a knowledgeable arborist with experience in tree care. Be careful to avoid untrained people who can cause more problems than they solve (Many existing problems were originally caused by bad pruning wounds.).

To locate a particular tree:
Numbers of index trees are indicated on the map. Using map and table, locate an index tree near the tree you wish to find. Using coordinates from the table, calculate distance and direction to the tree using the formulae below. Use a hand compass to determine direction and pace the distance to the tree.

DISTANCE:

$$D = \sqrt{(N1 - N2)^2 + (E1 - E2)^2}$$

BEARING:

$$A = \tan^{-1}\left(\frac{N1 - N2}{E1 - E2}\right)$$

If the tree being sought lies to the east (E2 > E1), the azimuth is 90° - A. If it lies to the west (E2 < E1), the azimuth is 270° - A. All addition or subtraction is algebraic; use the signs.

For example:

To go from Tree 3 (-40.50, 118.82) to Tree 22 (24.36, 622.04), the distance is:

$$D = \sqrt{(\ (N1)\ -\ (N2)\ )^2 + (\ (E1)\ -\ (E2)\ )^2}$$

$$D = \sqrt{((-40.50) - (24.36))^2 + ((118.82) - (622.04))^2}$$

$$D = \sqrt{(\ -64.86\ )^2 + (\ -503.22\ )^2}$$

$$D = \sqrt{(\ 4206.8196\ ) + (\ 253,230.3684\ )}$$

$$D = \sqrt{257,437.1880}$$

$$D = 507 \text{ Feet}$$

To go from Tree 3 to Tree 22, the bearing is:

$$A = \tan^{-1}\left(\frac{(N1)\ -\ (N2)}{(E1)\ -\ (E2)}\right)$$

$$A = \tan^{-1}\left(\frac{(-40.50) - (24.36)}{(118.82) - (622.04)}\right)$$

$$A = \tan^{-1}\left(\frac{(\ -64.86\ )}{(\ -503.22\ )}\right)$$

$$A = \tan^{-1}(.12889)$$

$$A = 7°$$

To convert this to an azimuth, first note that E2 > E1. This indicates that E2 is east of E1, so we use the equation:

$$B = 90^\circ - A$$

$$B = 90^\circ - 7^\circ$$

$$B = 83^\circ$$

Thus, starting at Tree 3, you should travel on a heading (azimuth) of 83° for a distance of 507.38 feet to reach Tree 22.

A Windbreak/Visual Barrier west of the office building would reduce wind in the office yard and west-central part of the picnic area, as well as hiding the fence and trash area behind the office. Rocky Mountain junipers provide a heavy foliage and are native to this site. At a six-foot spacing, a three-row planitng would require 120 seedlings.

To suppress grass and weed competition, weed barrier would be needed. 720 linear feet of six-foot weed barrier would be needed (2.4 100-yd. rolls). About 1000 wire staples would be needed to hold the barrier in place. Costs are summarized below, using CSFS' 1993 prices:

MATERIALS:

120 Large-pot RMJ @ $0.90 ea.:	$108.00
240 Yards weed barrier @ $1.085/Yd.:	260.40
1000 Six-inch 11-gauge staples @ $.0434 ea.:	43.40
	$411.80

LABOR:

Plant 120 trees (rocky site) @ $3.00 ea.:	$360.00
Lay 2.4 rolls weed barrier @ $80.00 ea.:	192.00
	$552.00

TOTAL COST:

Materials:	$411.80
Labor:	552.00
GRAND TOTAL:	$963.80

Forester's Note: Grass, in particular, is a vigorous competitor with seedlings. Suppression of grass is so important to the planting's health and growth, that I recommend not planting at all if weed barrier cannot be used.

Volunteers or untrained park personnel could plant the trees, getting passable results, but better results will be obtained with professional planters.

Failed spots must be replanted the following year: a hole in a windbreak is a disaster; the wind blows harder through the gap than it does on the open plain. Expect about 15% losses through the first winter.

The earlier in the season the trees are planted, the better their survival will be. They need time to adapt to the site and weed barrier needs about a month to kill off existing grass and weeds. These need to be killed as early as possible so they don't drink up the water. Try to complete the planting by Memorial Day, by mid-June at the latest.

At this time, there is not adequate space in the rest of the picnic area to add more trees, except along the edge of the mowed area. Elsewhere, open spaces are needed for recreation or are already occupied by trees. If new trees are added, they should be native species. All existing trees need protection from people. A ranger-naturalist might offer nature-walks around the picnic area, interpreting the trees and explaining harm done to a live tree by cutting into it; there are lots of examples. A CSFS forester might be willing to provide this service occasionally and/or prepare a tour and provide background information.

Areas receiving heavy use might benefit from being reseeded with high-impact grasses. One mix that is used in this situation consists of hard fescue (Durar) 50%, 4 pounds per acre, pls; little bluestem (Pastura) 25%, 3½ pounds per acre, pls; and Indian rice grass (Nezpar) 25%, 6 pounds per acre, pls. If the area is wetter than average, orchard grass is extremely tough and people-resistant. The seed should be applied in early spring, so that it can become established before summer droughts hit; or in August (under irrigation) so it can become esdtablished before winter freezes hit. Seed can also be applied on top of two or three inches of snow in October or November where it will lie dormant until spring. The seed should be raked in, if possible. This doubles the survival rate. A mulch should be applied and the area fenced off until the grass stands becomes firmly established.

NATIVE PLANT LIST:

Common Name	Scientific Name	Family
Oregon-grape	Berberis repens	Barberry
Baneberry	Actaea rubra	Buttercup
Pasque Flower	Anemone patens	Buttercup
Vase Flower	Clematis hirsutissima	Buttercup
Buttercup	Ranunculus sp.	Buttercup
Sulfur Flower	Eriogonum umbellatum	Buckwheat
Plains Pricklypear	Opuntia polyacantha	Cactus
Cow Parsnip	Heracleum lanatum	Carrot
Spreading dogbane	Apocynum androsaemifolium	Dogbane
Common Toadflax	Linaria vulgaris	Figwort
Yellow Owl's-clover	Orthocarpus luteus	Figwort
Great mullein	Verbascum thapsus	Figwort
Monument Plant	Frasera sp.	Gentian
Sticky Geranium	Geranium viscosissimum	Geranium
Kinnikinnik	Arctostaphylos uva-ursi	Heath
Mariposa Lily	Calochortus sp.	Lily
Sand Lily	Leucocrinum montanum	Lily
False Solomon's Seal	Smilacina racemosa	Lily
False Hellebore	Veratrum californicum	Lily
Yucca	Yucca sp.	Lily
Charlock	Brassica kaber	Mustard
White Sweetclover	Melilotus alba	Pea
Red Clover	Trifolium pratense	Pea
Dutch Clover	Trifolium repens	Pea
Skyrocket	Ipomopsis aggregata	Phlox
Grass Pink	Dianthus armeria	Pink
Prickly Poppy	Argemone polyanthemos	Poppy
Prairie Smoke	Geum triflorum	Rose
Shrubby Cinquefoil	Potentilla fruticosa	Rose
Woods Rose	Rosa woodsii	Rose
Prairie Star	Lithophragma parviflorum	Saxifrage
Bishop's Cap	Mitella sp.	Saxifrage
Yarrow	Achillea millefolium	Sunflower
Pearly Everlasting	Anaphalis margaritacea	Sunflower
Nuttall's Pussytoes	Antennaria parvifolia	Sunflower
English Daisy (Introduced)	Bellis perennis	Sunflower
Musk Thistle (Introduced)	Carduus nutans	Sunflower
Spreading Fleabane	Erigeron divergens	Sunflower
Common Sunflower	Helianthus annuus	Sunflower
Dotted Gayfeather	Liatris punctata	Sunflower
Mexican Hat	Ratibida columnaris	Sunflower
Meadow Goldenrod	Solidago canadensis	Sunflower
Common Dandelion	Taraxacum officinale	Sunflower
Yellow Salsify	Tragopogon porrifolius	Sunflower
New Mexico Vervain	Verbena macdougali	Vervain
Wood Nymph	Monese uniflora	Wintergreen
Pinedrop	Pterospora andromedea	Wintergreen
Wintergreen	Pyrola sp.	Wintergreen

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1994 ANNUAL WORK PLAN

1. ERADICATE DWARF-MISTLETOE FROM 3.0 ACRES OF INNER CANYON STAND A. DO THIS BY GIRDLING AND/OR INJECTING WITH HERBICIDE. POST CSFS WILDLIFE SIGNS ON GIRDLES TREES TO EXPLAIN THE ACTION TO THE PUBLIC.

2. BEGIN DWARF-MISTLETOE MONITORING PROGRAM IN CRESCENT MEADOWS STANDS B, D, E, G, H, I AND J.

3. THIN 100-FOOT STRIP ALONG GROSS RESERVOIR ROAD IN CRESCENT MEADOWS STAND A.

ABERT SQUIRREL HABITAT GUIDELINES

NEST SITES - Mature pine, 12" DBH, 45 feet tall with interlocking crowns. 150 - 250 square feet per acre Basal Area; Crown density greater than 70% in 1/5 acre groups.

FEEDING AREAS - 1/5 acre group of even-aged trees associated with nest sites.

FEEDING TREES - can be identified by presence of clipped twigs at base of trees. May be individual trees totally separate from groups.

1/5 ACRE - 93.4 feet per side on square
53 foot radius on circle

COVER AREAS - 100 to 150 Basal Area; 10 to 13 trees per group. Retain 6 minimum 11 and greater inch DBH. Crowns connect or touch. Groups within 50 feet of nest sites. 1/20 acre groups.

1/20 ACRE - 46.8 feet per side on square
26.4 feet radius on circle

PRESCRIPTION - Retain all existing nest sites and feed trees. Mark nest sites with tree tag. Use care in thinning cover and feeding sites. Group selection and individual tree selection to develop future group sites.

TURKEY HABITAT GUIDELINES

1. Identify turkey use areas - roost and feeding for winter time period.

2. Maintain all current roost sites.

3. Enhance current timber condition to provide roost sites near feeding sites such that similar number or more roost sites are maintained through time and, if possible, develop 2 roost sites per section.

4. Roost site characteristics - at least ten usable trees described as at least 30 feet tall, open crowned, large horizontal branches. No branches below 8 feet, size of roost 1/2 acre or more. Prefer ponderosa on easterly exposure located below ridge line. Shrub growth on roost sites should be minimal.

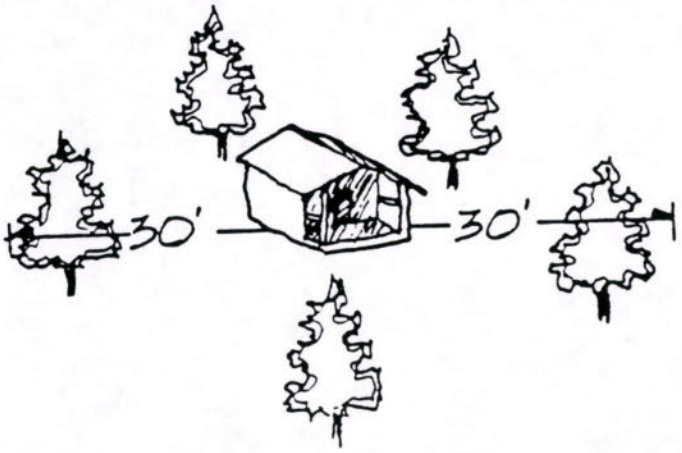
5. Time timber operations to maintain roost sites through time. Uneven-age management - group selection.

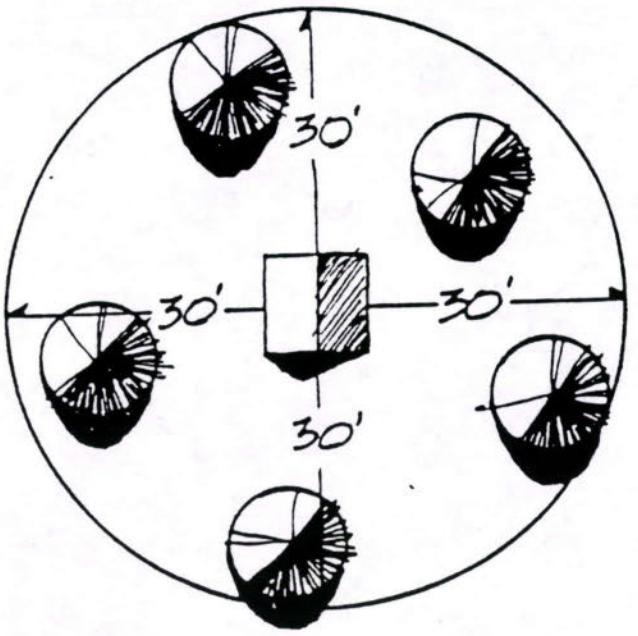
HOW SLOPE AFFECTS SAFETY ZONE

If your home is on a slope, you need to enlarge the Safety Zone. Safety Zone size will not affect fuel modification recommendations; it will only increase the area to be completed for your safety.

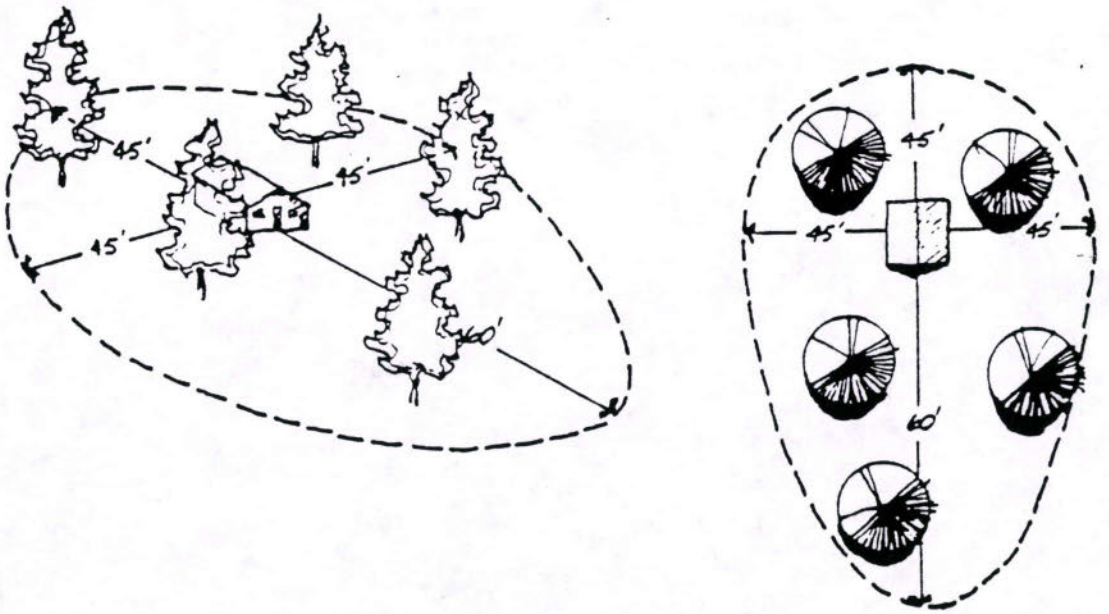
Because heat rises, fuels on slopes are preheated and will ignite faster. Consequently, wildfires will generally travel much faster upslope. To compensate for this phenomenon, Safety Zones are enlarged around homes on slopes and particularly on the downhill side. Special attention should be given to ladder fuels on all sloping terrain.

The following Safety Zone minimums are recommended for the stated slopes.

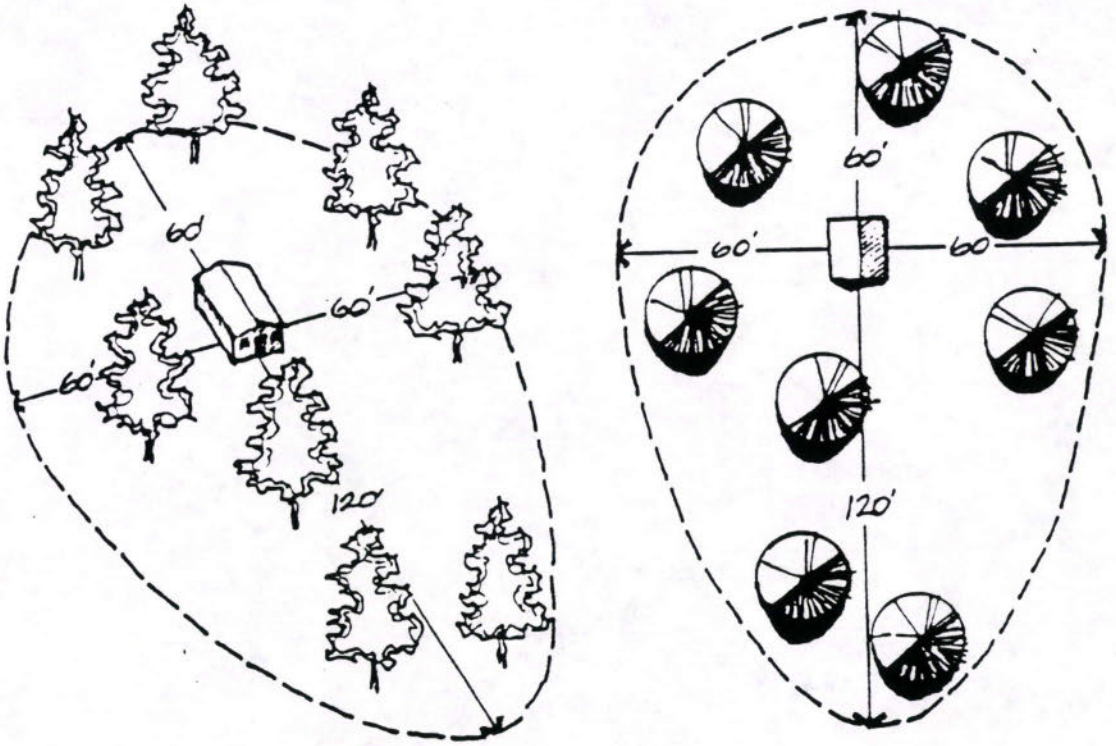




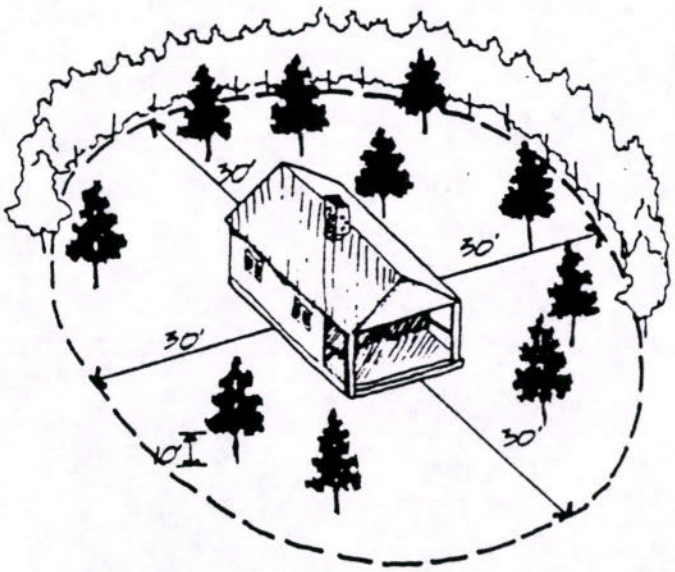
Level Terrain

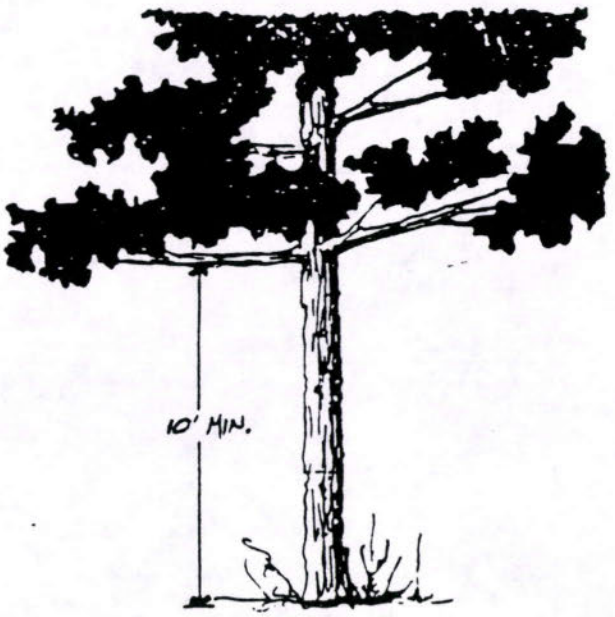


Thinned 30% Slope
Compared to level terrain, rate of fire spread increases by two.



Thinned 55 percent slope
Compared to level terrain, rate of fire spread increases by four.

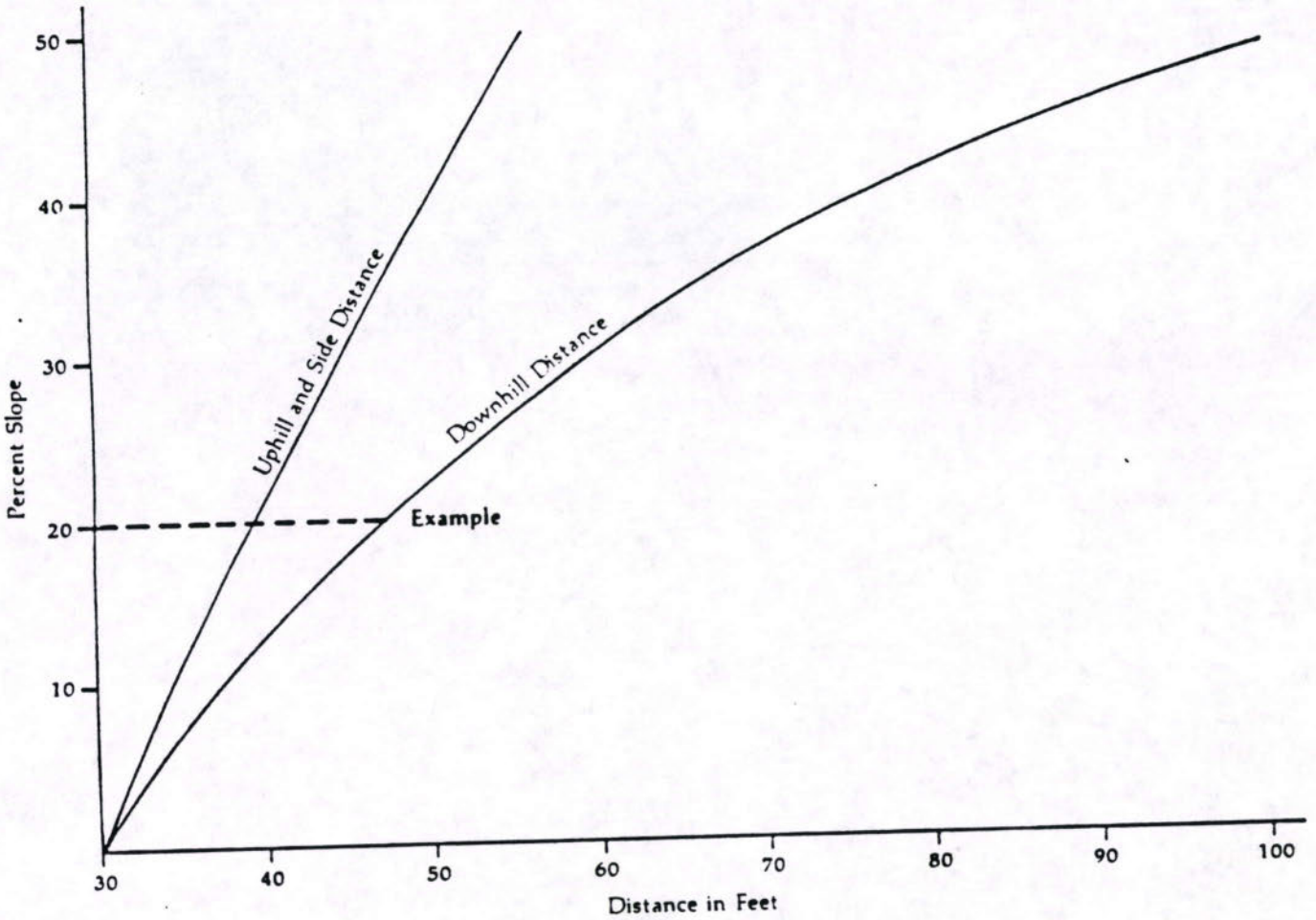




Thin trees within 30 feet of homesite if necessary. Adequate thinning is reached in the 30-foot area when tree crowns do not touch each other. Isolated clumps may be permissible under certain conditions. Following thinning, trees remaining within two tree heights of structures should be pruned of dead limbs to a height of 10 feet. Prune live branches to 10 feet from at least half the trees in this strip.

DETERMINING SAFETY ZONE DIMENSIONS

The increase in Safety Zone size is based on increased rate of fire spread at the slopes listed. If you live on slopes other than those listed, use the slope chart to help determine your side and downhill dimensions.



Example: If your home is situated on a 20 percent slope, your Safety Zone dimensions would be 40 feet on the uphill and sides of your home, and 47 feet on the downhill side.

Forest Insect
& Disease
Leaflet
5

U.S. Department
of Agriculture
Forest Service

Douglas-fir Beetle

Malcolm M. Furniss [1] and Peter W. Orr [2]

The Douglas-fir beetle (*Dendroctonus pseudotsugae* Hopk.) infests Douglas-fir throughout most of the range of that tree in Western United States, British Columbia, and Mexico. The beetle also produces broods in felled western larch but is unable to produce broods in living larch.

Douglas-fir beetles normally kill small groups of trees, but loss can be devastating during periodic outbreaks such as four that occurred in western Oregon and Washington from 1950 through 1969, during which 7.4 billion board feet of timber were killed. Between those outbreaks, annual losses averaged 10 million board feet. Other western forests have suffered similarly severe Douglas-fir mortality caused by the beetle. For example, in 1966 an outbreak in California killed 800 million board feet of timber and an outbreak in Idaho killed 109 million board feet of Douglas-fir between 1970 and 1973.

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[2] Entomologist, Forest Service, U.S. Department of Agriculture, Washington, D.C.

F-700348

Douglas-fir beetle infestations usually occur in trees damaged by windfalls, fire-scorch, or defoliation. Where susceptible trees are abundant, the beetle population can build up rapidly and spread to adjacent green timber. Damage is greatest in dense stands of mature Douglas-fir. Host tree susceptibility to attack is correlated with drought and root disease. Various fungi introduced by the beetles also contribute to mortality of infested trees.

External Evidence of Infestation

Reddish-orange frass consisting of fragments of phloem (inner bark) expelled from bark crevices by invading beetles is the first

sign that a tree has been attacked. Because wind and rain remove the frass, and because attacks are sometimes above reach, a tree must be examined carefully to determine if the beetles are present. Sometimes the most evident sign of infestation is clear resin exuding from entrance holes on the stem at the upper limit of the infestation (fig. 1).

Several months after the tree is infested, its foliage becomes discolored (fig. 2). First, the needles turn yellow, then sorrel, and finally, reddish brown. Although some trees are discolored as early as August, others may remain green until the following June. The time of year that this discoloration becomes visible varies with locality, date and intensity of infestation, elevation, and seasonal weather. Needles are shed and conks of the pouch fungus, *Cryptoporus volvatus* (Pk.) Hubbard, form on the outer bark during the year following infestation.

F-700344

Figure 1.—Beetle attacks cause pitch to exude from the uppermost infested portion of the tree.

Description of Life Stages

Adult Douglas-fir beetles are stout, somewhat cylindrical in cross section, and 4 to 6 mm long (fig. 3). The head and thorax are black, whereas the wing covers are usually reddish brown, becoming darker with age. The whitish eggs are 1 mm long. Eggs hatch into white, legless larvae with shiny, light-brown heads (fig. 4). Mature larvae transform into a brief pupal stage before becoming adults. Pupae are white, mummy-like, and have some adult features, including wings that are folded beneath the abdomen (fig. 5).

Seasonal History

The Douglas-fir beetle has one generation per year. Broods remain in the tree and overwinter mainly as adult beetles, but also as larvae. Depending on variations in locality and seasonal weather, adults that have over-

F-700343

Figure 2.—Group of trees killed by Douglas-fir beetles.

F-700345

Figure 3.—Adult Douglas-fir beetles and eggs.

F-700346

Figure 4.—Douglas-fir beetle larvae.

wintered generally emerge and fly to new host trees from April to early June. Larvae that have overwintered complete their development and emerge in the summer. Some adults that flew in the spring reemerge and make a second attack usually in late June and July.

Galleries and Characteristics of Infestation

The distinctive egg galleries (see cover) are constructed by the female beetles which bore through the bark and tunnel upward in the phloem, lightly engraving the sapwood. Galleries run parallel to the wood grain, commonly for lengths of 8 to 10 inches (20.3 to 25.4 cm); they are somewhat longer in windthrown trees. Galleries are packed with frass except at the top where the beetles are actively working. The females lay eggs alternately along opposite sides of the galleries as construction progresses. The eggs hatch in 1 to 3 weeks; the newly hatched larvae mine outward from the egg gallery in the phloem. These mines are visible on the inner surface of the phloem and increase in width as larvae molt and grow through four stages. During the final stage of growth, larvae construct pupal cells at the ends of their mines (fig. 5).

Tree stems are infested for varying lengths, but seldom higher than a top diameter of 6 or 8 inches (15.2 or 20.3 cm). Other bark beetles, *Scolytus tsugae* (Swain) and *Pseudohylesinus nebulosus* (LeConte), often occur in the top of the stem. In standing trees, Douglas-fir beetle egg galleries are usually more dense and the brood survival higher in the middle portion of the infested stem. In windthrown trees, egg galleries tend to be uniformly successful, but are generally more dense on the shaded underside. Douglas-fir beetles usually construct from 5 to 12 egg galleries

F-700347

Figure 5.—Douglas-fir beetle pupae.

per square foot (929 cm²) in standing trees, but only 2 to 6 galleries per square foot in windthrown trees.

Control

The resistance of live trees to bark beetle attack is the most important natural control factor. Climate and weather also strongly influence Douglas-fir beetle populations. Natural enemies include many parasitic or predacious insects, nematodes, and mites. Woodpeckers are not important predators of the beetle.

It has not been economically feasible to suppress Douglas-fir beetle outbreaks. During tests, broods in felled trees have been destroyed by sprays that fumigate the galleries. Similarly, insecticides that kill by contact have reduced attacks in test logs. Because felled trees are usually attacked less densely than are standing trees, the felled trap-tree method of control is inefficient.

Several pheromones—secretions that influence mating and aggregation—have been identified from the Douglas-fir beetle. When certain pheromones (frontalin or seudenol) are placed on live Douglas-firs or combined with volatile components of Douglas-fir-resin, flying beetles are attracted to the trees. Another pheromone (methylcyclohexenone) disrupts attraction. In nature, these pheromones serve to attract Douglas-fir beetles, helping them concentrate their numbers to overcome resistance of trees, and then to terminate attraction after mating has taken place. The potential usefulness of synthetic pheromones in surveying and managing beetle population is under study.

Management of Douglas-fir forests offers the best method of preventing or minimizing damage by the Douglas-fir beetle. Stands that are mature or overmature should be harvested. Younger stands should be thinned periodically to maintain vigorous growth and to reduce moisture stress. Such practices should be accompanied by salvage of windthrown or infested trees before beetle broods emerge from them.

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Furniss, Malcolm M., and Robert D. Oakes.

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SERVICE IN ACTION

COLORADO STATE UNIVERSITY EXTENSION SERVICE

Western spruce budworms

David A. Leatherman, J. Wayne Brewer and Robert E. Stevens[1/]

no. 5.543

Quick Facts

- Western spruce budworms are the most important tree defoliators in the West.
- Budworm larvae eat the new growth of host trees.
- Douglas-fir is the favored host in Colorado.
- Budworm has a one-year life cycle with moths flying in mid-summer.
- Budworm control measures usually are conducted in June.
- Current information on the status of this pest is available by calling Teletips tape #1725.2/

The western spruce budworm, *Choristoneura occidentalis* Freeman, is the most widely distributed and destructive forest defoliator in western North America. Several outbreaks have occurred in Colorado, the largest exceeding two million acres. In Colorado, the most commonly infested hosts are Douglas-fir and white fir. Occasionally Engelmann spruce, blue spruce and subalpine fir also become infested.

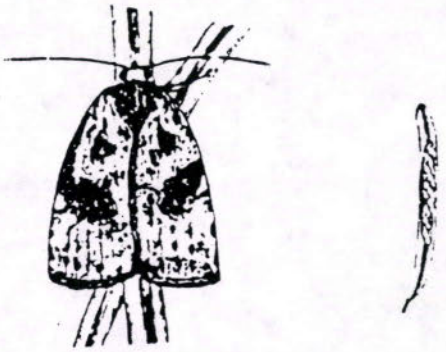

Figure 1: Western spruce budworm adult (left); budworm egg mass on a spruce needle (right).

Description and Life Cycle

Western spruce budworm adults (Figure 1, left) normally are small, mottled rusty-brown moths but color can vary from tan to almost black. In Colorado, they are present from late June to early August. After mating, females lay masses of overlapping green eggs (Figure 1, right) on the undersides of needles. The masses consist of 25-40 eggs that hatch in about 10 days. The young larvae do not feed but move to crevices under bark scales or lichens where they spin silken shelters called hibernaculae. There they remain dormant throughout the winter.

In late April or May, the larvae migrate to the foliage where they mine old needles or feed on host tree flowers. In a week or two, they enter developing buds, a habit to which their name is attributed. As the new needles lengthen, the rapidly growing larvae continue to feed. It is during this stage that most of the damage occurs. They web the new foliage together loosely and feed inside, where they are somewhat protected from predators and other enemies.

In the late larval stages (Figure 2), budworms have brownish heads and brownish-olive bodies and each body segment has two conspicuous pairs of white spots. About 40 days after feeding begins in the spring—usually about the end of June—the larvae pupate inside feeding webs or on foliage. Adult emergence occurs a week or so later and the cycle is complete. There is one generation per year.

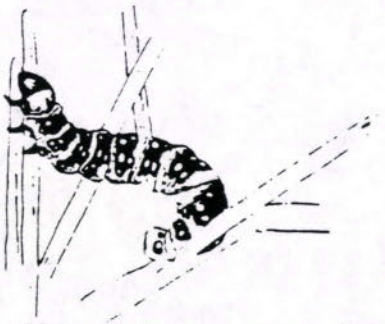

Figure 2: Mature larva of western spruce budworm.

1/ *David A. Leatherman, entomologist, Colorado State Forest Service; J. Wayne Brewer, CSU professor, department of zoology and entomology; and Robert E. Stevens, entomologist, Rocky Mountain Forest and Range Experiment Station (2/1/83)*

2/ *Teletips telephone numbers are 491-7387 in Fort Collins; 825-1588 in the Denver metro area; 1-800-332-2473 from all other Colorado exchanges.*

Damage and Associated Impact

Budworms are important because they have the potential to consume all new growth produced by host trees. Of course, it is the new needles that are most important in producing food for the tree, so the immediate effect of defoliation is a reduction in growth. To the homeowner, defoliation mostly means a loss of esthetic value. As defoliation progresses, both in extent and duration, more significant impacts are likely. The foliage, especially the branch tips, turns brown and dies. Twigs, branches or entire tops of trees may be killed. During long-running outbreaks of three to five years or more, about one tree in four will die.

Control

Budworm populations usually are held in check by a combination of predators, parasites, adverse climatic conditions or inadequate food supply. Spiders, insects and a variety of birds are important predators. Adverse weather conditions, particularly sudden freezing temperatures in late spring, may kill large numbers of larvae. A major factor in the termination of long-term outbreaks in forest stands appears to be starvation resulting from inadequate or nutritionally poor food sources. However, this may not be a factor in urban situations. Cultural practices such as thinning, watering and fertilizing, which promote tree vigor, may help trees better withstand repeated attacks.

Chemical control often is used to protect high-value trees from defoliation and associated damage. The materials listed below are among those registered for western spruce budworm control, and have been used with success in Colorado. They can be applied both from the ground and aerially. In either case, spraying should be timed to occur during the two to three weeks immediately following budbreak or flush of new growth. During most years this period occurs about mid-June.

Insecticide	Trade Name
acephate	Orthene
Bt (Bacillus thuringiensis)	Dipel, Thuricide
carbaryl	Sevin

Related Insects

A close relative of western spruce budworm, the so-called pine budworm, *Choristoneura lambertiana ponderosana* (Obraztsov) also is present in this area. This species attacks pines, especially ponderosa pine, and occasionally causes serious damage to individual trees. However, it is not normally an important defoliator in the urban environment.

References

Fellin, David G. and Jerald E. Dewey, *Western Spruce Budworm*. USDA Forest Service, Forest Insect and Disease Leaflet 53, 1982.

Furniss, R.L. and V.M. Carolin. *Western Forest Insects*. USDA Forest Service Miscellaneous Publication No. 1339, 1977.

•service in ACTION

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no. 5.528

Mountain Pine Beetle

David A. Leatherman[1]

QUICK FACTS

Mountain pine beetle (MPB) is the most important insect pest of Colorado's pine forests, often killing large numbers of trees annually during outbreaks.

MPB is the subject of Teletips #1705. Dial 825-1588 to hear this recorded phone message.

Trees under stress from various causes such as old age, crowding, poor growing site, and mechanical damage, are most likely to be attacked.

Short-term controls include spraying, burning, and peeling, while long-term remedies include various forest management practices like thinning.

Preventive sprays are available to protect green unattacked trees.

Mountain pine beetle, Dendroctonus ponderosae Hopkins, is native to western pine forests and is periodically epidemic in Colorado. Millions of trees have been killed during recent outbreaks. MPB infestations develop irrespective of property lines, being equally evident in wilderness areas, mountain subdivisions, and urban back yards. Even windbreak pines many miles from the mountains can succumb to beetles imported in materials like firewood.

COMMON NAMES

Mountain pine beetle, MPB, Black Hills beetle, Rocky Mountain pine beetle.

COLORADO HOST TREES

Commonly attacked and killed: Ponderosa pine, lodgepole pine, Scots (Scotch) pine and limber pine. Occasionally attacked and killed: Bristlecone pine and pinon pine. Rarely attacked and killed: Austrian pine and other pines not mentioned above.

LIFE CYCLE

This bark beetle has a one-year life cycle in Colorado. In late summer adults leave the dead, brown-needled trees in which they developed and attack living, green trees. After tunneling just beneath the bark and mating, female beetles each lay about 75 eggs in vertical tunnels called egg galleries. Soon these eggs hatch into larvae that feed outward from the vertically-oriented egg gallery. Larvae overwinter in infested trees.

Most larval feeding occurs in spring, with transformation (pupation stage) into the adult stage occurring in early summer. Emergence of new adults can begin in early July and may continue through September. However, the great majority of beetles exit trees during late July (lodgepole pine) and mid-August (ponderosa pine). All control efforts should, of course, be completed prior to beetle emergence. Upon emerging, beetles attack living trees, often in mass, and the cycle begins anew.

A key part of this cycle is the beetle's role in transmitting bluestain fungi. Spores of these fungi contaminate the bodies of all MPB (and many other bark

[1]David A. Leatherman, Entomologist, Colorado State Forest Service

beetle species) and are introduced into trees during attack. Beetle attacks are successful only when both larval and fungal development progress. Thus, the network of beetle galleries plus growing bluestain act together to disrupt the tree's water transport system. Rapid tree death results.

SIGNS AND SYMPTOMS OF ATTACK

1. Popcorn-shaped masses of resin called pitch tubes on trunk (may be brown to white in color).
2. Boring dust in bark crevices and around tree's base.
3. Bluestained sapwood (check at more than one point around tree's circumference).
4. Characteristic MPB galleries beneath bark.
5. Evidence of woodpecker feeding on trunk (patches of bark removed, bark flakes laying on ground or snow below tree).
6. Fading or browning of entire tree crown (usually 8-10 months after successful MPB attack).
7. Live MPB eggs, larvae, pupae and/or adults in galleries under the bark.

Finding live stages of MPB actively feeding as in the last symptom (7), is by far the most certain indicator a tree is infested and needs attention. Thus, a hatchet for removing bark is needed to check trees correctly.

CONTROL

Natural - Woodpeckers, certain insects and other natural agents, and extreme weather all exert at least partial control on MPB populations. However, if forest or tree conditions are favorable for beetle outbreaks, these checks are not capable of keeping populations at low levels.

Physical and mechanical - Burning (log decks or as firewood), peeling, some types of milling, exposing to solar radiation, and burying can all be effective treatments. Some of these obviously waste the wood resource.

Chemical - Remember to READ AND FOLLOW ALL LABEL INSTRUCTIONS WHEN USING ANY PESTICIDE. The current status of chemicals for direct use in killing MPB within infested trees or logs is confusing. Formerly approved materials, like ethylene dibromide (EDB), cacodylic acid (Silvisar 510), and lindane are now completely banned, unavailable, or restricted to use by certain individuals in certain situations. Consult a local CSFS or Cooperative Extension office for current information on chemical control options.

PREVENTION

Cultural - Forest management practices, such as thinning, which increase the vigor of potential host trees, are the best long-term approach to minimizing MPB losses. Consult a professional forester for assistance in deciding which prescription is best for your land.

Chemical - Certain formulations of carbaryl are registered for early summer spraying of live, green pines to prevent MPB attack. These products go by several trade names. Read the label for application instructions. This preventive is quite effective through one MPB flight period per application. In lodgepole pine areas, recent evidence indicates one spraying may provide satisfactory protection through two flights (two years).

MISCELLANEOUS INFORMATION

Once MPB has successfully infested a tree, nothing practical can be done to save that particular tree.

Under epidemic or outbreak conditions, enough beetles can emerge from an infested tree to kill about two same size trees the following year.

IPS and related beetles that emerge early in summer are often mistaken for MPB, leading to early reports of "MPB is flying." Be sure to properly identify the beetle you find before sounding the alarm.

Trees from which MPB have already emerged do not need to be treated. (Look for numerous, round, pitch-free exit holes in bark.)

The direction and spread rate of a beetle infestation is virtually impossible to predict. However, attacked trees or tree groups are usually adjacent or near previously killed trees or tree groups.

Special lures, called pheromones, are now being used in some areas to attract and concentrate beetles into trees where some method of managing them is more feasible.

SERVICE IN ACTION
COLORADO STATE UNIVERSITY EXTENSION SERVICE

Pine needle scale

characteristics and control on evergreens

W.M. Hantsbarger
and Wayne Brewer[1/]

no. 5.514

Quick Facts

Pine needle scale attacks spruce, pine and fir trees in Colorado.
It overwinters in the egg stage.
The insect hatches in the spring and quickly attaches itself to the tree's needles.
Good control of pine needle scale can be obtained by applying an insecticide just prior to hatching and then two more times at 7- to 10-day intervals.
Proper timing is important if insecticide applications are to be successful.

Pine needle scale is a serious pest of spruce, pine and fir. When numerous, the scale insects cause the needles to turn yellow by withdrawing the plant juices. By the time the needles begin to show evidence of injury, it is too late to prevent them from dying. The trees are not able to replace the damaged needles. Consequently, it is advisable to check trees periodically to discover any signs of infestation.

Description and Cycle

The adult (mother) pine needle scale is about one-eighth inch (.3 millimeters) long, grayish-white and found attached to the needles of evergreens. This insect passes the winter in the form of tiny, purplish eggs under the old mother scale.

The average hatching date in Colorado is about June 1. This will vary with altitude and climate, however.

The newly hatched crawlers are minute in size and resemble tiny aphids. They can be best seen with aid of a magnifying glass. The crawlers move about for a short time and then settle down and insert their beaks into the needles. They stay in this location throughout their lives.

Soon after attaching themselves to a needle, they begin to secrete a waxy covering and start to transform into adult scales. The insect becomes fully grown in July or August.

At higher elevations there is only one generation a year. A second generation of crawlers may occur in August at lower elevations.

Control

Dormant sprays such as lime-sulfur or oil emulsions sometimes are used in the spring prior to the appearance of new growth. Both have disadvantages.

Lime-sulfur deposits a visible residue on the tree and may discolor paint if the chemical drifts to a nearby building.

Dormant oils are likely to remove the bloom from needles and under certain conditions may seriously injure them.

When using either oil or lime-sulfur, directions on the manufacturer's label should be carefully followed.

Summer sprays can be effective, provided that the application is properly timed. The spray application should be made as soon as possible after the eggs hatch and before the insect becomes protected by its waxy covering.

If the approximate hatching date for an area is known, it may be advisable to make the first spray application just before the hatch. Two additional applications at 7- to 10-day intervals should be made. The following materials as a summer spray give good control of pine needle scale:

Diazinon—25-percent liquid concentrate at the rate of two teaspoons per gallon (10 milliliters per 3.8 liters) of water.

Malathion—55-percent emulsifiable concentrate at the rate of two tablespoons per gallon (30 ml per 3.8 l) of water.

Sevin—50-percent wettable powder at the rate of two tablespoons per gallon (30 ml per 3.8 l) of water.

Orthene—15-percent emulsifiable concentrate at the rate of four teaspoons per gallon (20 ml per 3.8 l) of water.

1/ *W. M. Hantsbarger, CSU extension associate professor, entomology; Wayne Brewer, CSU associate professor, entomology (revised 9/1/79)*

SERVICE IN. ACTION
COLORADO STATE UNIVERSITY COOPERATIVE EXTENSION

IPS beetles—characteristics and control

Whitney S. Cranshaw, David Leatherman[1]

no. 5.558

Quick Facts

- Ips are a common group of bark beetles that infest pine and spruce.
- Ips rarely attack healthy trees. Most problems with Ips occur to newly transplanted pines or when plants are under stress.
- Several generations of Ips can occur in a season.
- In general, preventive treatments for Ips are best applied by early May.

Ips beetles are a common group of bark beetles that develop within pine and spruce. Most commonly, Ips beetles occur in recently felled logs (including firewood) and dying trees. Ips beetles occasionally also will attack and kill living trees. Newly transplanted trees or trees placed in unsuitable locations are especially vulnerable. Root injuries, drought and other stresses also can make a tree susceptible to attack by Ips beetles.

Evidence of Ips beetle activity is the accumulation of very fine sawdust at an entrance hole on the trunk. Larger sawdust particles (2-3 millimeters) or the presence of pitch tubes on the bark usually are *not* indications of Ips beetle activity. Confirmation of Ips beetle infestation is best done by peeling off the bark. Egg galleries produced by these insects branch from a central chamber and remain largely clear of sawdust (fig. 2). Blue stain fungi generally infect wood that is colonized by Ips beetles.

Ips beetles are far less important threats to tree health than are *Dendroctonus* bark beetles. *Dendroctonus* beetles include some serious pests such as the mountain pine beetle (discussed in Service in Action 5.528) and the Douglas fir beetle. *Dendroctonus* bark beetles can be separated from Ips beetles by examining the hind wing covers of the adult insects (fig. 1).

Another group of quite small beetles (1/16 inch by 1/8 inch) called *twig beetles* also infest twigs, limbs and trunks of weakened coniferous trees. They resemble miniature Ips or *Dendroctonus* beetles, but in general are confined to small diameter tree parts. Their biology, importance and treatment is similar to that for Ips.

History and Habits

Approximately 10 species of Ips occur in Colorado. Many are restricted to a few tree species but others can be found in almost all species of pine. They range from 1/8 inch to 1/4 inch in length.

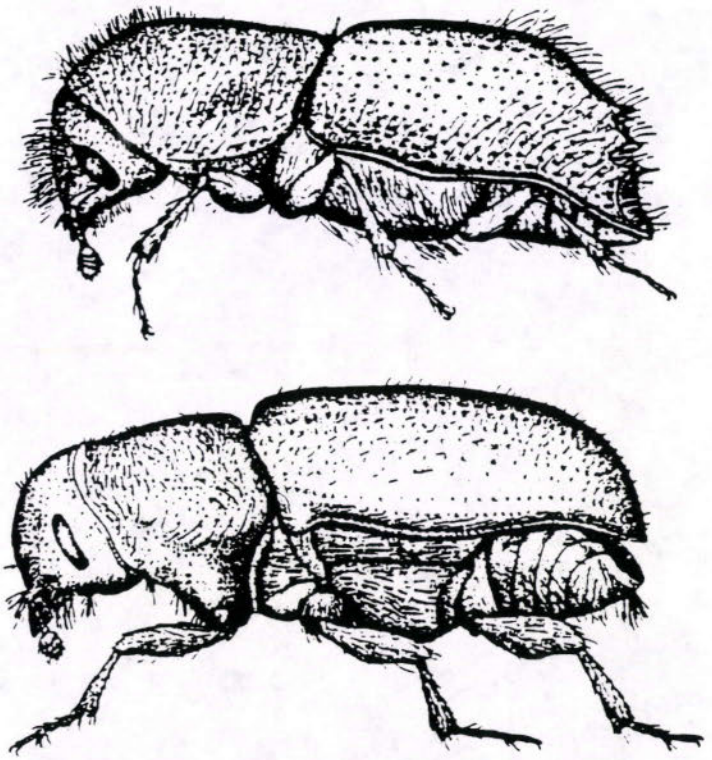

Figure 1: Adult Ips (top) versus Dendroctonus (bottom). Note jagged hind wing covers of Ips. Actual size of Ips from 3 to 6.5 mm; Dendroctonus 3 to 8 mm.

[1]*Whitney S. Cranshaw, CSU assistant professor, department of entomology; David A. Leatherman, entomologist, Colorado State Forest Service. Drawings by Thomas Weissling and David Leatherman.*

Most Ips overwinter as larvae or adult beetles. In mid-spring to early summer, adult beetles emerge, fly about and begin to tunnel into logs, tree trunks and branches. Male beetles move into the trees first and construct a small (3-6 millimeter diameter) "nuptial chamber" in the cambium of the wood. Female beetles then follow and construct the radiating egg galleries, which often form a "Y" or "H"-shaped pattern (fig. 1).

After eggs hatch, the small, white grub-like larvae begin to feed and tunnel perpendicular to the egg galleries. The larvae and tunnels increase in size as the insect grows and when full-grown the larvae pupate at the end of the tunnel. Adult beetles bore through the bark and emerge to mate and infest other wood. As many as three to four generations of Ips beetles may occur in a single year. These generations overlap and all life stages may be found in a single tree.

Ips beetles are only able to successfully invade and breed in stressed or dead and dying trees. Healthy trees are less attractive to the beetles and are capable of "flushing out" the beetles. Rarely, when high numbers of Ips beetles are present, mass beetle attacks can kill apparently healthy trees. Freshly felled logs may also support a generation of Ips beetles.

Control

To prevent Ips beetle attacks use practices which promote vigorous tree growth. This involves careful site location and soil preparation when transplanting trees. Adequate watering as trees get established is also very important in preventing Ips infestation.

Ips beetle populations can build up rapidly in felled timber and recently cut logs. The presence of these materials near susceptible trees can greatly increase the potential for damaging numbers of Ips attacks. These breeding materials should be removed, burned, or debarked before beetles emerge.

Insecticidal control of Ips beetles usually is not justified. However, newly transplanted landscape trees, particularly when located near Ips beetle breeding sites, may benefit from a preventive insecticide application. Products containing carbaryl (Sevin, Sevimol, Pine Tree and Ornamental Spray, etc.) commonly are used for this purpose, applied to the tree trunk and major limbs. Lindane and chlorpyrifis (Dursban) may also be used as preventive treatments. Once Ips have moved into the wood the tree can not be saved and beetle control is limited. Preventive sprays should be applied to susceptible trees before beetle activity in the spring. One application per year is usually sufficient. In general, applications made in early May are most appropriate but occasionally beetle attack can occur earlier. (Note: Lindane should not be diluted with petroleum products when application is to live trees. Such dilution is suitable only for application to cut logs.)

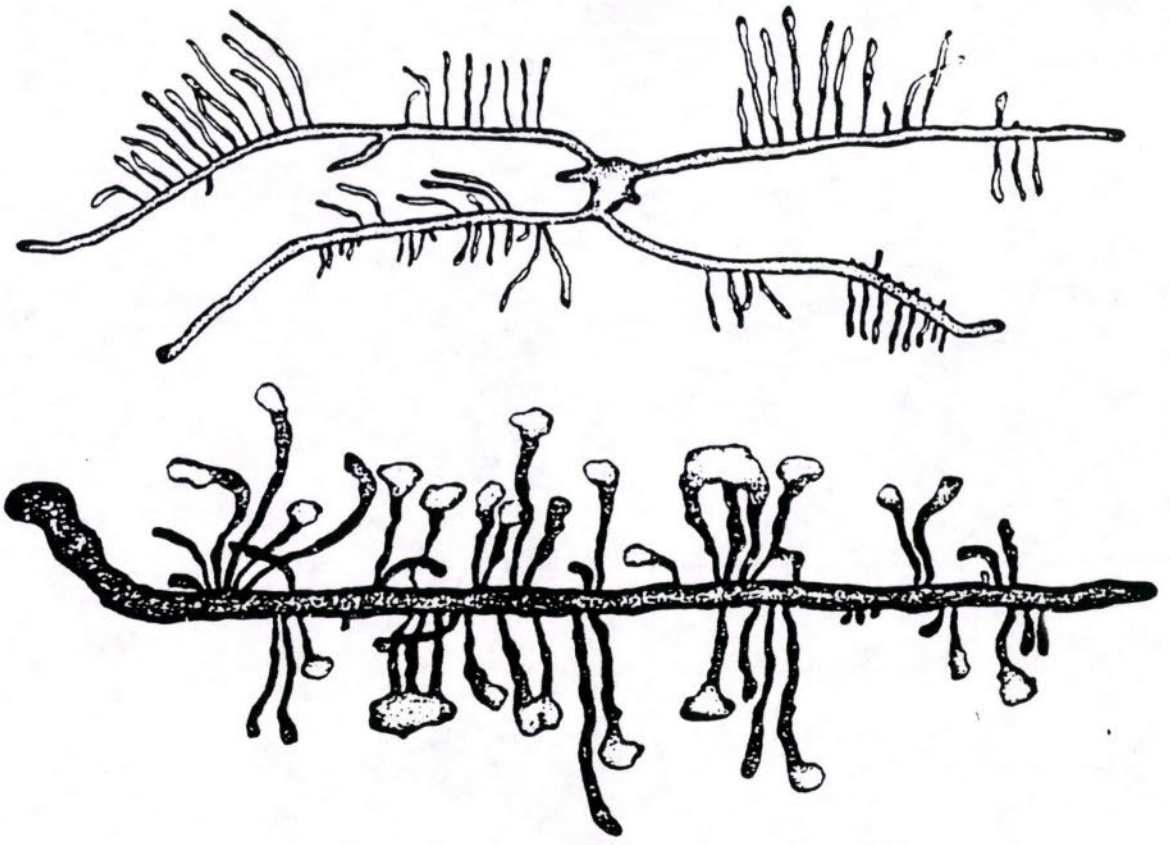

Figure 2: Typical egg and larval galleries produced by Ips (top) versus Dendroctonus (bottom). Note central chamber in Ips gallery.

Western Gall Rust Cankers in Lodgepole Pine

Roger S. Peterson

IT IS STRANGE that the most common and damaging fungus canker on Rocky Mountain lodgepole pine has never been fully described. Branch galls caused by western gall rust (*Peridermium harknessii* Moore) are well known, but the malformation that this fungus causes on trunks (Fig. 1) has generally been ignored, blamed on dwarfmistletoes, or ascribed to other rust fungi. With present increased utilization of lodgepole, (*Pinus contorta* Dougl. ex Loud.), canker damage can no longer be neglected.

Nomenclature, Hosts, and Range

Gall rust cankers are known in various parts of the West as "hip-cankers," "cat-faces," "cat's eyes," and "monkey-faces." The causal fungus is similarly supplied with a variety of names, of which the oldest and clearest is *Peridermium harknessii*. The nomenclatural tangle has been discussed elsewhere (*4, 8, 9*).

Probably all of the western hard pines can serve as hosts to this native rust, and specimens have been collected on seven pine species, in all the states and provinces west of the Great Plains and north of Mexico (*9*). On jack pine (*Pinus banksiana* Lamb.) the fungus is probably transcontinental (*1, 10, 11, 12*). Many eastern and exotic hard pine species have proved susceptible to western gall rust in plantations and in inoculation experiments (*2, 9*). However, only on lodgepole pine and to a lesser extent on ponderosa pine are abundant trunk cankers found; on other hosts only branch galls and short-lived stem galls are common.

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The research reported was conducted from the Station's Forest Disease Laboratory at Fort Collins, Colo.

Development on Lodgepole Pine

Where gall rust infects a pine branch, it stimulates the host cambium to excessive activity, and a distinct gall develops. The resulting deformity is a subglobose, pear-shaped, or occasionally fusiform gall, well illustrated by Hubert (*5*). The twig may be encircled in a single year, but more frequently the gall extends around a branch less rapidly, and several years may be required to complete the circuit. Because of breakup of the gall bark, the branch part distal to the gall dies within a few years of encirclement. The rust dies with its host branch. Such galls do little harm unless they are numerous enough to kill most of a tree's needle-bearing branches. Tree mortality from galls appears to be uncommon in all but the seedling stage of lodgepole pine.

On main stems girdling may progress as it does on branches (top of Fig. 1), but usually there is quite a different result. Although a globose gall begins to form, tangential growth of the rust does not overtake that of the host, and the gall is limited to one side of the trunk (Fig. 2). As on the branch gall, breakup of the bark causes death of this "primary gall" after two or more years. But unlike the branch, a trunk offers adjacent living areas for the rust to invade. Growth of the rust is mainly at right angles to the stem axis. Therefore, to the left and right of the primary gall, "secondary galls" develop from the newly-invaded cambium, and appear as concentric, curved ridges (Fig. 3).

This process—invasion, gall formation, and necrosis—occurs repeatedly during growth of a canker, and in one instance was observed to extend over at least 277 years. Active cankers 200 years old are common in virgin lodgepole. The primary gall may eventually be buried by later growth of nearby tissue, or it may break off if it is on a branch base.

Presence of a canker on one side of a tree stimulates growth in the rust-free sides of the trunk (Fig. 1). The uninfected wood is not pathological; unlike the xylem in galls, it is composed of normal tracheids and rays in the usual ratio of abundance. But this unbalanced growth, as much as the diseased tissue itself, contributes to the cull caused by gall rust.

Vertical growth of the rust is usually slight. Occasionally, however, the mycelium (body of fungus filaments) elongates relatively rapidly parallel to the wood grain. Abnormal cell divisions in the invaded cambium give rise to narrow ridges extending upward or downward from the main horizontal zone of growth (Fig. 3).

The vertical extent of a trunk canker is not limited to the region invaded by the fungus. Exposed dead wood often extends in long triangles both up and down (Fig. 4). These triangles, although sometimes similar to *Peridermium stalactiformc* cankers resulting from vertical growth of that rust (*8*), have not been observed to contain mycelium. No aecia (spore sacs) or mycelium could be located at their edges in hundreds of field examinations or scores of microscope sections.[1] Often the triangles

[1]The staining technique of Jewell (*6*) was used. In all sections from gall tissue, mycelium was clearly differentiated by this method. No mycelium was observed in any section taken more than one centimeter from a gall.

are mirror images above and below the center, and they may extend for six feet in each direction.

Unusual canker shapes result when the bark of a primary gall lives for many years, or when the rust dies out on one side. In the first instance, a hemispherical gall up to two feet in diameter may result; in the second, there develops a "one-sided" canker in which the primary gall is at an edge rather than the center.

FIG. 1.—Two forms of attack by *Peridermium harknessii* on lodgepole pine: the original stem leader was girdled by a globose gall (arrow), and rust cankers have deformed the lower trunk. Roosevelt National Forest, Colo.

Damage to Pines

Economic loss resulting from *P. harknessii* in lodgepole pine results mainly from cull caused by trunk cankers. This view is in contrast to that of Hubert, (*5*), who believed that gall rust causes "considerable damage to seedlings and minor damage to mature trees." It is true that in the Inland Empire of the Northwest, where Hubert made his observations, thousands of seedlings per acre may be killed by this pathogen. Near Nordman, Idaho, there are now stands in which serious, though temporary, understocking has been caused by gall rust. Yet the area is remarkably free of gallrust trunk cankers.

To the east, however, in the Continental Divide area of Montana and southward to northern Colorado and northeastern Utah, where lodgepole is the principal commercial species, seedling mortality does not seem to be an important damage factor. Cankers, on the other hand, can be found in most lodgepole stands, and in some more than half of the trees are affected. No extensive surveys have been made to evaluate gallrust damage on a regional basis; the few available figures are for selected plots (*5*, *9*).

The majority of *P. harknessii* cankers penetrate deep into the trunk, and cause serious malformation and weakness. Cankered trees are useless for transmission line poles (*7*). Boards sawn from such trunks are structurally weak and irregularly discolored. Merchantable sized cankered stems cannot be fully utilized for sawlogs, the amount of cull depending on the number and position of the lesions that must be cut out. Short products such as cross-ties, mine props, and pulpwood offer the only economic utilization of some badly cankered stands that could otherwise be cut for sawtimber. Effects of the highly resinous rust-infected tissue on pulp quality have not been assessed.

Control

[illegible] gall [illegible] except in the course of [illegible] and in intermediate cuts, [illegible] cankered stems should be [illegible]ored. It is hoped that with increasing knowledge of the pathogen's life cycle more general silvicultural controls can be suggested.

[illegible]ning of branch galls is possible and has been carried out in [illegible]ponderosa and Scotch pine plantations, but it is generally impractic[illegible]. [illegible] a gall is within a few centimeters of the trunk, it can [illegible] little harm.

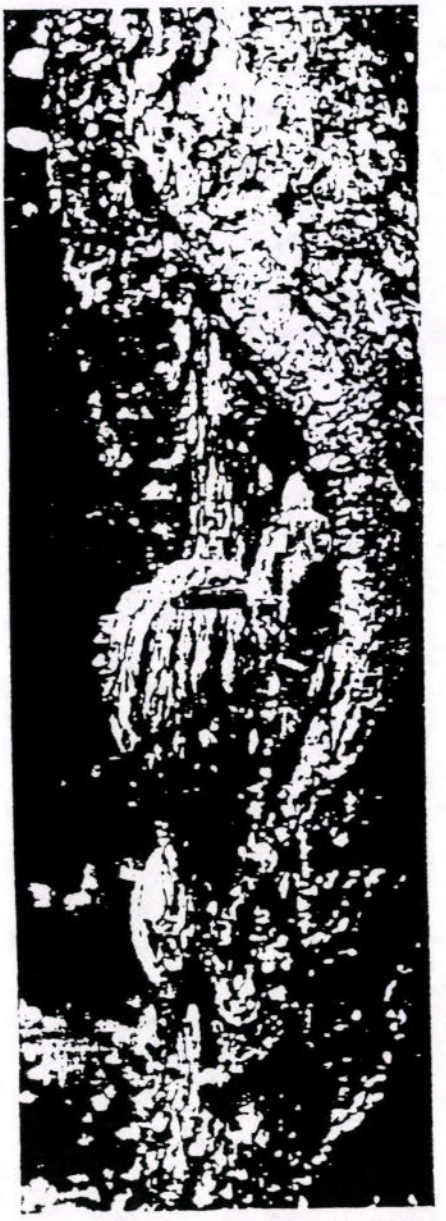

FIG. 2.—A hemispherical gall at the center of a *Peridermium harknessii* canker on lodgepole pine. Usually the primary gall is less obvious because of overgrowth by the surrounding tissue. Kootenai National Forest, Mont.

FIG. 3.—Secondary galls near the center of a *Peridermium harknessii* canker on lodgepole pine. Each gall lives for a few years, then is succeeded by a new swelling further from the primary gall. Roosevelt National Forest, Colo.

FIG. 4.—An elongated gall rust canker on lodgepole pine. The rust itself was limited to the center of the canker. Roosevelt National Forest, Colo.

In 1933, Colorado foresters cut the rust cankers from seven lodgepole pines. No noticeable decay was introduced in the resulting scars after twelve years, and rust infection was eliminated in five or six of the trees, whereas untreated cankers continued to develop.[2] Of course such surgery is practical only for trees of special value.

Possibilities of control by antibiotics and by breeding for host resistance have scarcely been explored for this disease, but they offer some hope.

P. harknessii should be carefully excluded from regions beyond its range, particularly the southeastern states and Europe. Probably the southern pines have already been "exposed" and conditions have not proved suitable for the fungus, but this is not a certainty. Scotch pine in Europe has not been exposed, so far as is known. Boyce (*3*) in this regard called *P. harknessii* "probably the most dangerous of all tree rusts if disseminated from its present range."

[2]Heaton, P. L. *Peridermium* canker study; progress report. Pike National Forest, Colorado Springs. December 5, 1945. Typescript. 2 pp. 1945.

Summary

On lodgepole pine, trunk cankers are the principal form of damage due to western gall rust, *Peridermium harknessii*. Cankers caused by this parasite begin growth from primary galls. After breakup of the gall bark, the fungus spreads horizontally to adjacent tissue, where secondary galls develop. Cankers may increase in size for a century or two without killing the host.

Trunk malformations caused by gall rust result in significant cull, at least where infested stands are cut for poles or sawlogs. Control, except by cutting out diseased stems during thinning, is not yet practicable.

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SERVICE IN ACTION

COLORADO STATE UNIVERSITY EXTENSION SERVICE

Dwarf mistletoe

C. E. Swift and
L. E. Dickens[1/]

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.

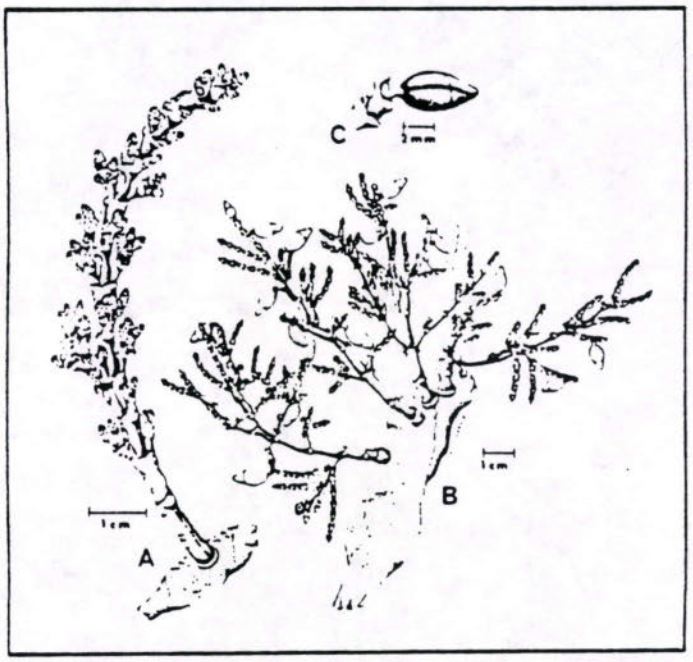

Figure 1: *Arceuthobium vaginatum*, in July; A, male plant; B, female plant; C, fruit. *Illustrations courtesy of Frank G. Hawksworth, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.*

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 early September.

This parasite is easily identifiable 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 the 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 (see Figure 2). 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 infestations 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

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[1/] *C. E. Swift, CSU extension agent, horticulture, and L. E. Dickens, CSU extension professor, plant pathology (5/15/79)*

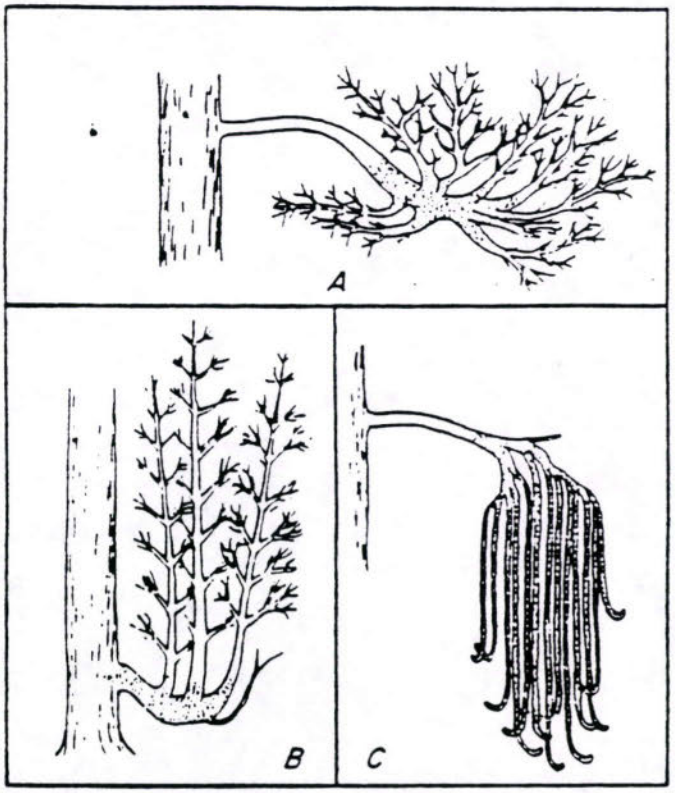

Figure 2: Three types of brooms associated with dwarf mistletoe on ponderosa pine. Stippled areas indicate the areas actually invaded by the parasite.

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 tree 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 on branches closer than indicated should be cut down to remove a future source of reinfection.

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 replanted to:

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

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

Englemann 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.

service in ACTION

Colorado State University Cooperative Extension

no. 5.567

Ponderosa pine budworm

Robert E. Stevens[1]

Quick Facts

- Ponderosa pine budworm larvae feed on new growth of ponderosa pines, causing—in extreme cases—severe tree damage.
- This budworm has a one-year life cycle. Moths fly in midsummer and the insects overwinter as tiny larvae in protected niches in bark crevices.
- Control with insecticides may be appropriate in some cases.

The ponderosa pine budworm, *Choristoneura lambertiana ponderosana* Obraztsov, is a common pest of ponderosa pine in Colorado and New Mexico.

Closely related to the western spruce budworm (see Service in Action 5.543), which in Colorado is a major pest of Douglas-fir, this insect is a member of a species group that confines its attention to pines. Some foresters know it as the "sugar-pine tortrix"; also it is called the "pine budworm."

In Colorado, outbreaks can be expected in most ponderosa pine areas. Recent (and current) activity has centered in the Pagosa Springs-Durango area, and in the St. Vrain river drainage between Lyons and Estes Park.

Description and Life Cycle

Ponderosa pine budworm adults are small moths, mostly golden, with wingspans about ¾ inch. Like all moths, they go through four life stages—adult, egg, larva (or caterpillar) and pupa. The larva, which is the feeding stage, is the form that causes damage to trees. Fully-developed larvae (Figure 1), are about ¾-inch long, generally tan in color, not particularly hairy, and have brown head capsules. Pupae are also tan, and under ½-inch long.

Figure 1: Ponderosa pine budworm larva (above) and pupa in infested shoot.

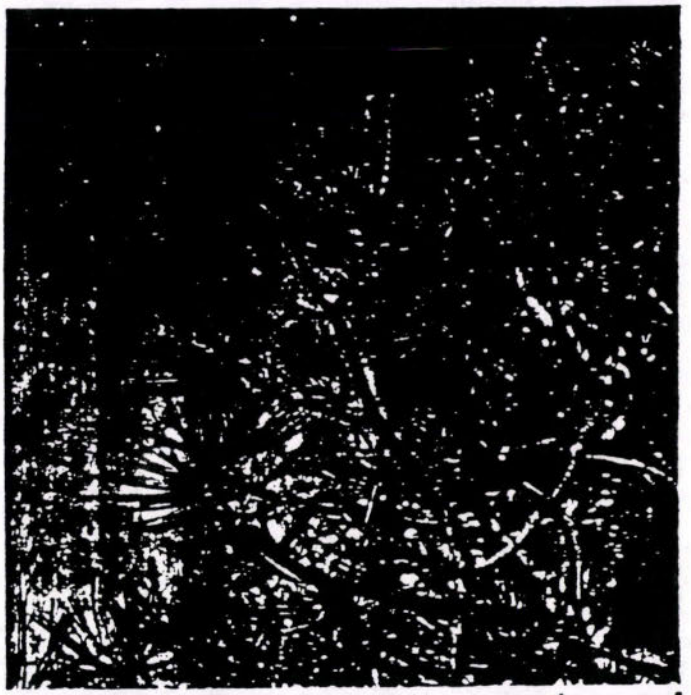

Figure 2: Pine shoots damaged by several years of budworm feeding.

[1]*Richard E. Stevens, research associate (forest entomologist), department of entomology (5/86)*

The entire life cycle takes one year (Figure 3). Moths are present in late July and early August. They lay eggs in overlapping shingle-like clusters on pine needles. The eggs hatch within a few days and the tiny caterpillars immediately seek shelter in protected locations on twigs and branches where they overwinter. The caterpillars emerge from their overwintering sites in April or May and begin feeding on newly-developing foliage. Young larvae mine within the sheaths surrounding new needle bundles while the larger larvae are more general feeders, but also only on new foliage.

The larvae continue to feed as the foliage develops, going through a succession of moults before reaching the pupal stage in late June. The feeding larvae produce a great deal of silk that surrounds the bases of the needles on which the larvae feed. Pupation takes place amid the damaged foliage, the pupae being somewhat protected by the silk.

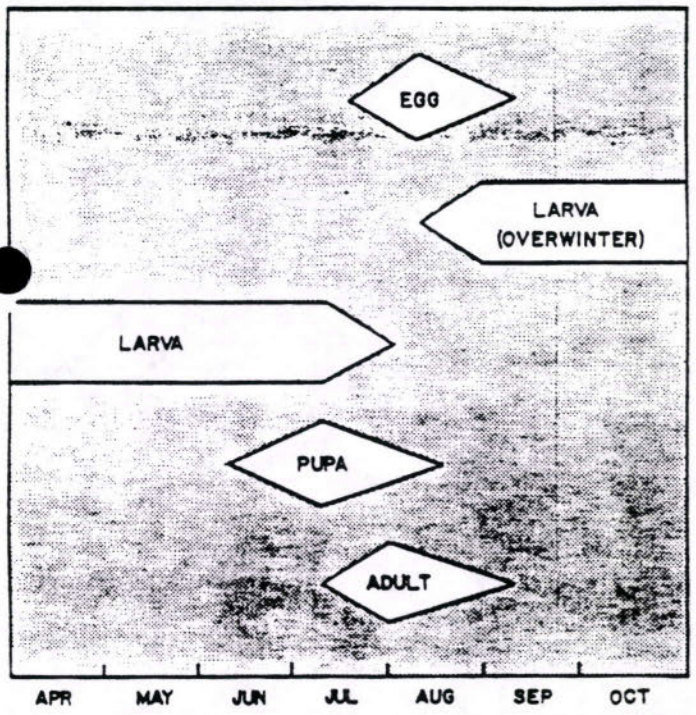

Figure 3: Generalized life history of ponderosa pine budworm.

Damage

Damage is caused by the larvae feeding on the needles. If there are many larvae, much of the new foliage on a tree can be consumed. If this happens several years in a row, serious tree damage can result. Severely affected trees have thin crowns with conspicuous bare stubs at the branch ends (Figure 2). Many trees severely stunted by ponderosa pine budworm currently can be found in the major outbreak areas. The ponderosa pine budworm normally is not considered a tree-killer; however recent experience has shown that it can constitute an important problem.

Control

Although the ponderosa pine budworm has the usual set of natural control factors (including parasitic insects, predators such as birds, and physical factors of the environment such as temperature extremes), persistent outbreaks do occur and use of insecticides may be warranted. But there is little experience with applied control of this species. Laboratory studies and limited field applications have shown the budworm to be susceptible to several insecticides commonly used against forest defoliators. Foliar sprays have appeared more encouraging than insecticide implants, although data are scanty. Timing is particularly important in achieving good control, and in general the insecticide applications should coincide with early larval feeding. Consult Cooperative Extension, State Forestry, or U.S. Forest Service specialists for details of suggested treatments.

Associated Insects

Other species of pine defoliators can coexist in the shoots along with the ponderosa pine budworm. Common species in Colorado include the pine needle-sheath miner, *Zelleria haimbachi* Busck; the pine butterfly, *Neophasia menapia* (Felder and Felder); and the ponderosa pine needle miner, *Coleotechnites ponderosae* Hodges and Stevens. As with any suspected pest, proper identification should precede an evaluation for proposed control actions; i.e. know what pest with which you are dealing.

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SERVICE IN ACTION
COLORADO STATE UNIVERSITY COOPERATIVE EXTENSION

Ponderosa pine needle miners

Robert E. Stevens, David A. Leatherman and J. Wayne Brewer[1/]

no. 5.544

Quick Facts

- Needle miners are tiny caterpillars that feed inside pine needles.
- Needle miners cause needles to turn brown and drop prematurely in many Colorado locations.
- Infested trees look unhealthy; persistent infestation may affect tree vigor.
- Chemical controls have been developed for high-value situations.

For the past 10 years, needle miners have caused considerable damage to ponderosa pine foliage in several Colorado localities. Although needle miner feeding usually has not been serious from the standpoint of tree health, it is considered a problem because it detracts from tree appearance. This is particularly true where trees have high value, as in urban situations, or around homes in mountain subdivisions.

Figure 1: Ponderosa pine needle miner adult moth (left); larva (right), both greatly enlarged.

Description and Life Cycle

The adult ponderosa pine needle miner, *Coleotechnites ponderosae* Hodges and Stevens, is a very small, fragile, dark gray moth with a wingspan of about 13 millimeters (½ inch)—see Figure 1. Like many insects, needle miners go through four life stages—egg, larva, pupa and adult. The larval or caterpillar stage of this moth (Figure 1, right) feeds inside pine needles hollowing them out. This habit is the reason for the species' common name.

There is at least one other species of pine needle miner in this area, *Coleotechnites edulicola*, which is found in pinyon. Its life history and habits are similar to those of the ponderosa pine needle miner, but so far it has not been considered a serious pest in Colorado.

The ponderosa pine needle miner has one generation per year (see Figure 3). Adults fly and lay eggs in late summer, often inside old previously mined needles. The eggs hatch in early fall, and the tiny larvae move to green needles, bore in near the needle tip, and begin mining. Development continues slowly through the winter, then accelerates rapidly with the coming of warm spring weather. Each larva completes its development in a single needle, and pupates in the mined-out needle in midsummer. Mined needles drop prematurely.

Figure 2: Ponderosa pine needle miner larva inside mined needle.

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[1]*Robert E. Stevens, former entomologist, Rocky Mountain Forest and Range Experiment Station; David A. Leatherman, entomologist, Colorado State Forest Service; and J. Wayne Brewer, former CSU professor, department of zoology and entomology (revised 6/86)*

Evidences of Infestation

Browning of foliage is the first readily noticeable evidence of needle miner activity. Close inspection, including holding the needles so the light can shine through them, reveals that some of the needles have been hollowed out from within (see Figure 2), a sure sign of needle miner activity. Other factors such as total tree death caused by bark beetles, needle diseases, or misuse of herbicides also cause needles to fade; however, only needle miners hollow out the needles.

Needle miner activity is sometimes confused with results of bark beetle-caused damage, particularly that caused by mountain pine beetle. However, mountain pine beetles cause all the needles to fade, not just some of them. Also, only the outer portions of needle miner-infested needles fade; the inner parts remain green.

Effects of Infestation

So far, most needle miner-caused defoliation has been an esthetic problem only, as the miners prefer older needles, and these provide relatively little nutrient to the tree. However, recent evidence suggests that several years' heavy needle miner feeding does result in visible tree decline; that is, reduced needle length and needle numbers.

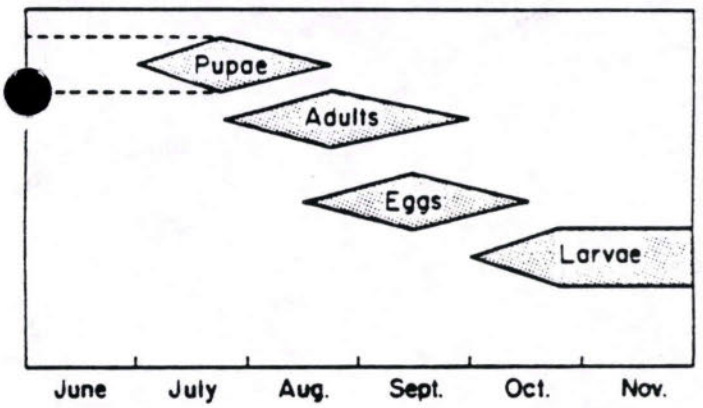


Figure 3: Life cycle of ponderosa pine needle miner.

Control

Although needle miners have the usual complement of natural control factors, including parasitic insects (a biotic factor) and adverse weather (an abiotic or physical factor), these have not been effective lately in keeping numbers of needle miners below damaging levels.

Research has shown that high-value trees can be protected against needle miners using either of two different chemical control approaches. The more conventional of these is individual tree spraying with commercial hydraulic spray equipment; the other involves use of insecticide implants inserted into holes drilled into the tree trunk. Both techniques depend on the same insecticide, acephate (Orthene), and both are aimed at preventing establishment of the young larvae in green, uninfested needles. Timing is highly critical in the case of the foliar spray. In either case some time is necessary before the trees' appearance will improve, as the old mined needles drop off. Treatments are summarized below.

Treatments	Materials	Time to Apply
Foliar sprays	Acephate in Orthene tree and ornamental spray	When eggs hatch—around mid-September
Trunk implants	Acephate in Acecap 97 implants	Mid-June to mid-September

References

Stevens, Robert E. *A Ponderosa Pine Needle Miner in the Colorado Front Range*. USDA Forest Service Research Note RM-228, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo., 1973.

Stevens, Robert E., and David A. Leatherman. *Implants and Sprays for Control of Ponderosa Pine Needle Miner in Individual Trees*. USDA Forest Service Research Note RM-420, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo., 1982.

SERVICE IN ACTION
COLORADO STATE UNIVERSITY EXTENSION SERVICE

Aspen and poplar leaf spots

D. P. Miller and W. R. Jacobi[1]

no. 7.209

Quick Facts

- Foliage diseases on aspen, cottonwoods and other poplar species are caused primarily by four species of fungi in Colorado: black leaf spot caused by Marssonina; shoot blight caused by Venturia; ink spot disease caused by Ciborinia; common leaf rust on aspen and poplars caused by Melampsora.
- Foliage diseases develop readily in wet, cool weather.
- Foliage diseases on aspen and cottonwood decrease the trees' aesthetic value and can cause premature defoliation. If the outbreak becomes severe, the general health of the tree can be affected.
- Raking and disposing of leaves and pruning out branches with cankers will reduce future disease occurrence.
- Severe outbreaks of these diseases can be prevented by timely fungicide application.

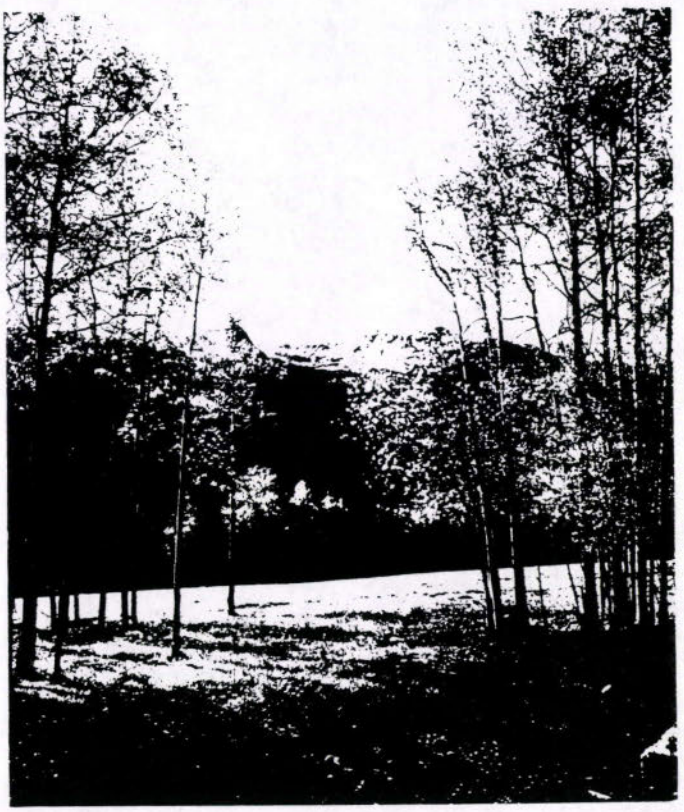
Foliage diseases can reduce the aesthetic value of aspen and cottonwood. Occasionally, a severe disease outbreak causes premature defoliation or dieback of parts of the tree. If leaves are lost early in the season, a second growth of foliage may occur and tree health will not be seriously affected. Defoliation in mid-summer with subsequent refoliation, however, may prevent the tree from fully hardening off before cold weather or reduce the amount of stored food. This leads to increased danger of frost damage, reduced growth and predisposition to other diseases or insects. If leaves are lost late in the season, the tree will not refoliate or lose much vigor.

Marssonina Leaf Spot

The fungus *Marssonina* causes the most common foliage disease on aspen and poplars.

Symptoms and Signs: *Marssonina* leaf spots are dark brown flecks, occasionally with yellow halos, up to about one-sixteenth of an inch (2 mm) in diameter (see Figure 1). Mature spots characteristically have a white center. On severely infected leaves, in wet weather, several spots may fuse to form large dead patches (see Figure 2). Spots also may develop on leaf petioles and succulent new shoots.

Disease Cycle: *Marssonina* survives the winter on fallen leaves that were infected the previous year. With spring and warmer, wet weather, the fungus produces microscopic "seeds" or spores that are carried by the wind and infect emerging leaves. Early infections are rarely serious, but if the weather remains favorable, spores from these



[1]*D. P. Miller, student and W. R. Jacobi, CSU assistant professor, plant pathology and weed science (8/85)*

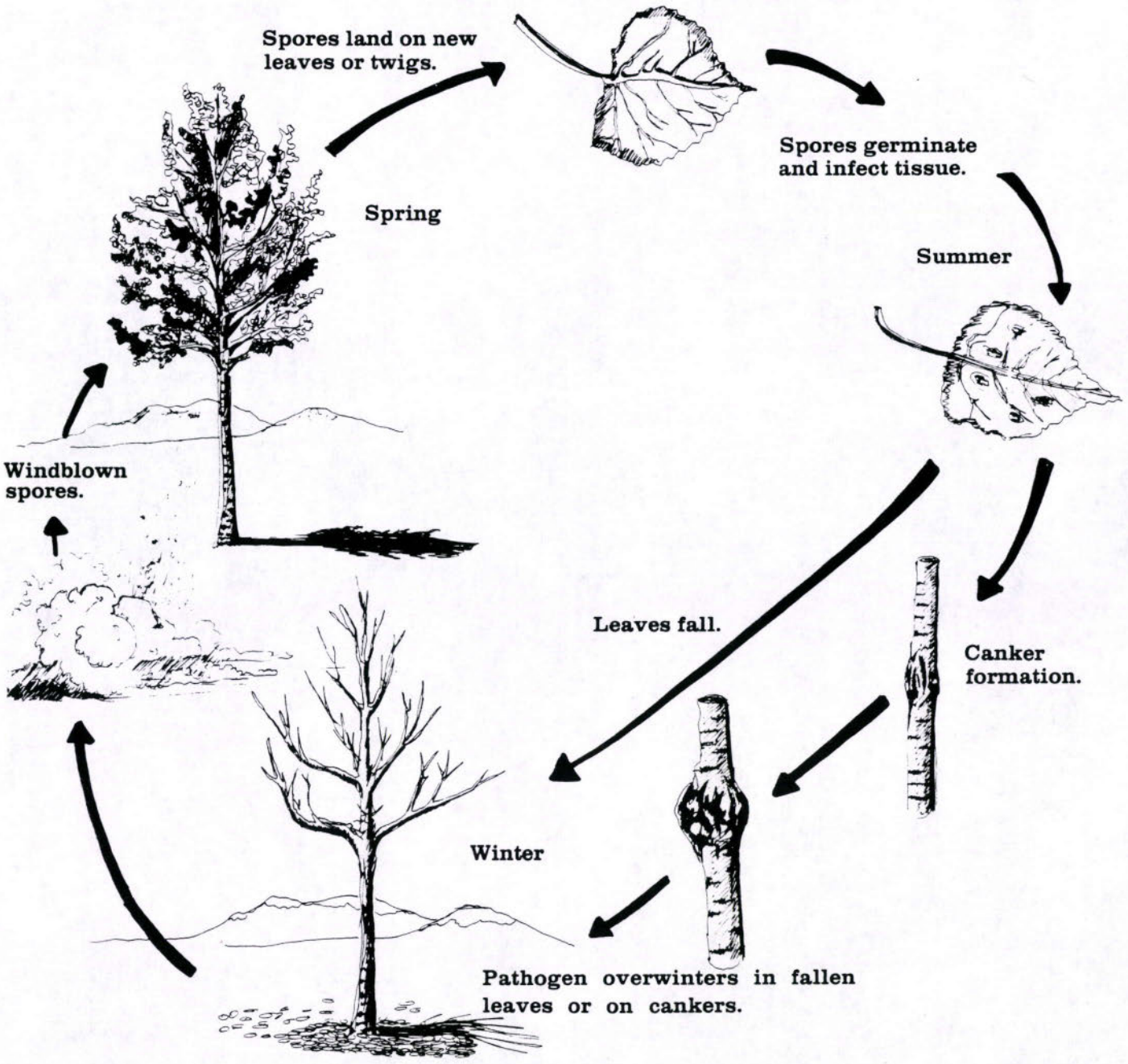


Figure 7: Generalized disease cycle of aspen and poplar leaf spots. Cankers form on trees with shoot blight only.

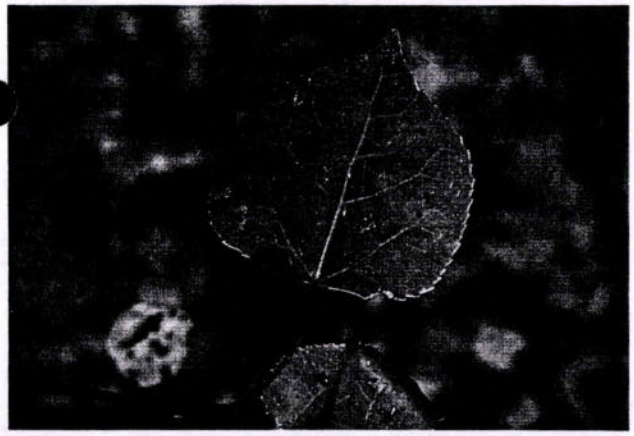


Figure 1: Marssonina leaf spot on aspen, yellow discoloration or young infection.

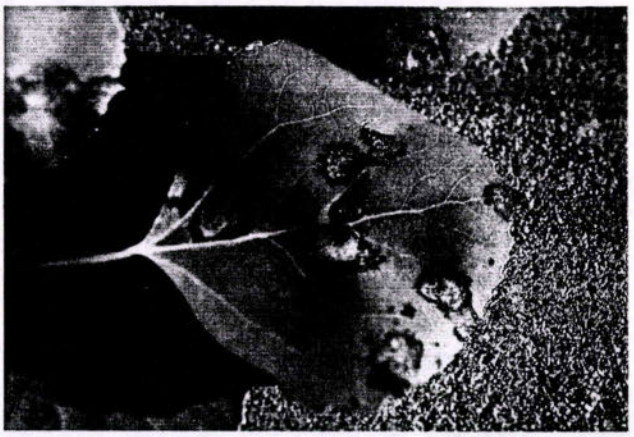


Figure 2: Marssonina leaf spot on aspen, late symptoms.

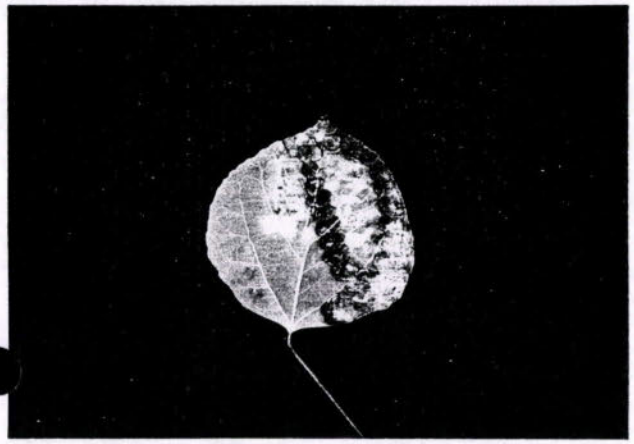


Figure 3: Ink spot disease on aspen in early summer.

Figure 4: Ink spot disease on aspen in mid-summer.

Figure 5: Shoot blight on aspen showing black and curled stem.

Figure 6: Rust on aspen with yellow discoloration.

infections can cause a widespread secondary infection. Heavy secondary infections become visible later in the growing season and cause premature defoliation of infected leaves.

Ink Spot of Aspen

The fungus *Ciborinia* causes a leaf disease of aspen commonly known as ink spot.

Symptoms and Signs: The first symptoms of ink spot appear in late spring to early summer as tan to brown areas on the upper leaf surfaces. Concentric, discolored ring patterns may become visible as the fungus advances through the leaf (see Figure 3). Infected leaves may be totally brown by mid-summer while adjacent uninfected leaves remain green. Raised black bodies begin to appear on affected brown leaves. These hard masses of fungal material are oval shaped and nearly ¼ inch (4-6 mm) long. These are the "ink spots" which give the disease its common name (see Figure 4). In late summer these spots fall out, leaving a characteristic "shot hole" effect on leaves that remain on the tree. This disease is especially prevalent in dense aspen stands. Early defoliation may cause reduced growth damage.

Disease Cycle: The hard fungal tissue masses that fall from infected leaves are the overwintering stage of the fungus. Wet spring weather stimulates spore production. Spores are blown and splashed from the ground to developing leaves. Ink spot rarely reaches epidemic proportions because the fungus completes only one infection cycle per year.

Leaf and Shoot Blight

Leaf and shoot blight, caused by the fungus *Venturia* is a disease affecting young aspen and cottonwood tissue.

Symptoms and Signs: In the spring symptoms first become visible on leaves near shoots infected the previous season. Brown to blackened, irregularly shaped areas spread through the leaves causing them to dry and become distorted. Typically, the fungus spreads down through the succulent new shoot, which blackens and curls to resemble a shepherd's crook (see Figure 5). Death of new shoots causes distorted, shrubby growth.

Disease Cycle: The leaf and shoot blight fungus survives the winter mainly on shoots infected the previous season. Spores are windblown early in the season and infect newly expanding leaves and shoots. As the season progresses, uninfected tissue becomes more resistant to the disease.

Leaf Rusts

A rust disease caused by the fungus *Melampsora* is often seen on aspen and cottonwood. Though common, this disease rarely causes serious problems.

Symptoms and Signs: The disease is recognized easily by small yellow-orange pustules scattered on the lower leaf surfaces (see Figure 6).

Disease Cycle: The life cycle of this fungus is somewhat complex because it requires two different tree hosts. During wet spring weather spores are released from the fungus, which has overwintered on fallen cottonwood or aspen leaves. These spores infect evergreens, such as Douglas fir, pine, fir or spruce, where they cause very little damage. After two to three weeks, spores are produced on these evergreen hosts and are blown to aspen or cottonwood leaves. Once the rust is established on aspen or cottonwood hosts, it can multiply rapidly under favorable wet conditions throughout the summer. Several years of heavy infections can cause some growth losses, especially on younger trees. Fallen infected leaves shelter the fungus until the next year's disease cycle.

Disease Management

Sanitation is an effective control for some foliar diseases. Fall removal of infected leaves, twigs and branches can reduce the amount of disease the next spring. *Marssonina* leaf spot, ink spot and leaf rust can be reduced by raking and destroying infected leaves. The shoot blight fungus overwinters in diseased stems and twigs, so it must be pruned out to reduce new infections.

Keeping leaves as dry as possible reduces the incidence of leaf spots. Watering in early morning so leaves will dry out and keep sprinkler patterns adjusted so leaves won't wilt will help prevent leaf diseases.

Fungicides, if applied early enough, can prevent foliage diseases. Spraying will prevent only new infections; it will not cure leaves already infected. If an infection is developing on particularly valuable trees, or if there is good reason to believe an infection is imminent, the trees can be sprayed with fungicides. Trees that perennially have foliar diseases should be sprayed at bud break and then two or three times during the growing season at 12- to 14-day intervals. Check with your county extension agent or district forester for specific fungicide recommendations.

service in ACTION

Colorado State University Cooperative Extension

no. 5.522

Boxelder bugs: characteristics and control

Frank B. Peairs[1]

Quick Facts

- Boxelder bugs are a nuisance in and around homes from fall through early spring.
- The bug overwinters as an adult in protected places such as houses or other buildings.
- Removing female boxelder trees is the most permanent solution to the problem, although this may not be practical or desirable.
- Laundry detergents offer safe, effective control when applied directly to the insects.
- Insecticide sprays can be used for control on boxelder trees and building exteriors.

For most people, the boxelder bug needs no introduction. This bug is about one-half inch (1.3 centimeters) long as an adult, black in color with three red lines on the thorax (that part just behind the head), a red line along each side, and a diagonal red line on each wing. The immature forms (Figure 1) are smaller and are easily distinguished from the adults (Figure 2) by their red abdomens and lack of wings. Boxelder bugs become a nuisance in and around homes from fall through early spring.

Boxelder bugs' favorite food is boxelder seed pods, which are found only on the female boxelder tree. These bugs seldom develop in sufficient numbers to be a nuisance unless a female boxelder tree is in the neighborhood.

Overwintering

The boxelder bug overwinters as an adult in protected places such as houses and other buildings, cracks or crevices in walls, doors, under windows and around foundations, particularly on south and west exposures. In the spring, when tree buds open, small red eggs are laid in cracks and crevices in the bark of female boxelder trees. The eggs later hatch into young nymphs that are wingless and bright red in color with some black markings. These young bugs usually are found on low vegetation near boxelder trees until seeds are formed on the tree, which they then start to feed on.

Boxelder bugs are primarily a nuisance pest, annoying residents by crawling on exteriors and inside dwellings on warm fall and winter days. They also will stain draperies and other light-colored surfaces, and produce an unpleasant odor when crushed, but these are not major problems. They do not bite people, nor will they damage house plants.

Types of Control

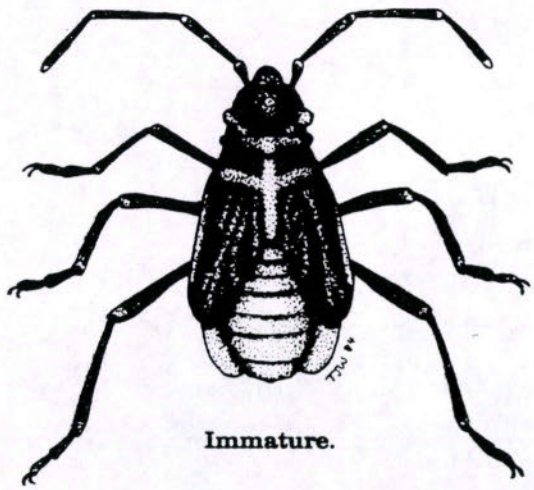
The most permanent solution to the boxelder bug problem would be the complete removal of female boxelder trees from a neighborhood, although this may not be practical or desirable. Since boxelder bugs usually overwinter near the trees that they feed on, the removal of one or two problem trees may be of benefit to the homeowner. Infested trees also can be sprayed with insecticides (Table 1) while the bugs are still concentrated on the trees, before they move into the house.

When the bugs begin to congregate on dwelling exteriors, these areas also may be sprayed (Table 2). Treat all resting and hiding places. The insecticides in Table 2 will give residual control, that is, treated surfaces will remain toxic to the insects

[1]*Frank B. Peairs, Colorado State University Cooperative Extension entomologist and assistant professor, entomology (4/88)*

for several days. Laundry detergents are cheap, safe and effective when applied directly to boxelder bugs. Drawbacks of detergent sprays are that they will kill only if they contact the insect directly and they may damage vegetation.

Screening or sealing cracks or other entrances into the dwelling is important because once boxelder bugs have entered the home, control becomes more difficult. A vacuum cleaner is useful for controlling bugs that have entered the house. Household insecticidal aerosols and many sprayable household cleaners also are effective when applied directly to individual insects. These measures will provide temporary relief only, because the boxelder bugs may continue to enter the home as they move about on warmer days throughout the fall, winter and early spring.



Immature.

Table 1: Insecticides for controlling boxelder bugs on boxelder trees.

Insecticide	Dilution
Diazinon Malathion Sevin (carbaryl)	Several concentrations are available; follow label directions for dilution for use on ornamentals.

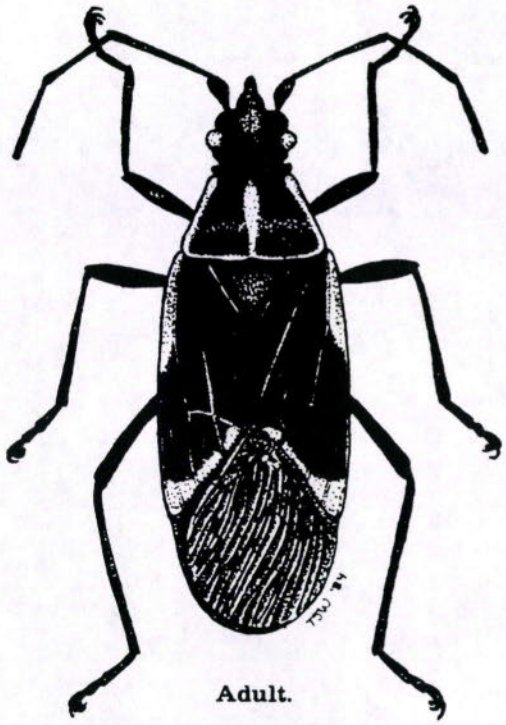
Read the insecticide label carefully before using.

Table 2: Insecticides for controlling boxelder bugs on building exteriors.

Insecticide	Dilution
Diazinon (liquid formulations)	¾-1½ fluid ounces *active ingredient*/gal.*
Sevin (carbaryl) (powder, not dust formulations)	1/6 ounce *active ingredient*/gal
Most laundry detergents	1 cup/gal

Read the insecticide label carefully before using.

**For example, if the formulation is 25 percent diazinon, 3 to 6 ounces will contain the desired three-fourth to 1½ fluid ounces active ingredient.*



Adult.

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Colorado State University Cooperative Extension

no. 5.507

Spider mites

characteristics and control

Whitney S. Cranshaw, Susan L. Miller[1]

Quick Facts

- Spider mites are common around the home and are most damaging during hot, dry periods.
- Mites damage plants by sucking out their juices.
- Only garden sprays containing a miticide should be used to control mite infestations. Common insecticides do not affect mites but do kill insects that feed on mites.

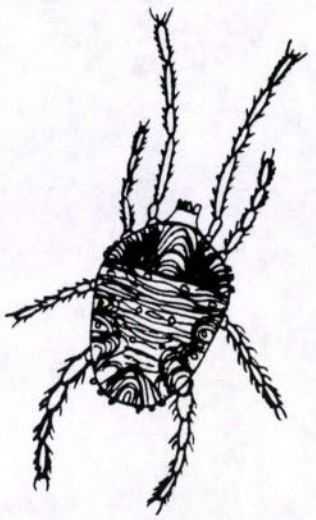
Spider mites are common pest problems on almost all plants grown in Colorado. A wide variety of trees, shrubs, flowers, vegetables and even lawns may suffer injury during periodic spider mite outbreaks.

Spider mites are very small, often difficult to see with the unaided eye. Colors range from red, brown, yellow and green, depending on the species of spider mite and seasonal changes in appearance. Spider mites are not true insects, instead being classified in the group known as arachnids including the spiders, ticks, daddy longlegs and scorpions.

Spider mites feed by sucking plant juices with piercing mouthparts. Usually mites will feed on the underside of the leaves, out of direct sunlight. The area surrounding the feeding site is often lightly flecked, giving the plant a speckled appearance. During heavy infestations, the foliage will take on a general discoloration (bronzing). Mite damage is often associated with premature drop of infested leaves and needles. Problems with mite injury are most common at hot, dry sites.

Webbing is often produced by spider mites during high populations. Webbing is particularly common with the two-spotted and spruce spider mites. Webbing provides some protection for the mites and their eggs from extreme temperatures and from natural enemies. (Note: Often, webbing by spiders and cottonwood fluff is confused with spider mite webbing.)

Two-spotted mite.



Clover mite.

History and Habits

Several pest species of spider mites occur in Colorado. The *two-spotted spider mite* is the most widespread, being found on almost all plants and occurring as serious pest problems on both indoor and outdoor plants. Problems with two-spotted spider mite are particularly common on such garden plants as beans, raspberries and roses. *Spruce spider mites* commonly damage evergreens such as juniper and spruce. *Honeylocust spider mites* can be found throughout the state on honeylocust, particularly those planted along roads and

Whitney S. Cranshaw, Colorado State University Cooperative Extension entomologist and assistant professor, Susan L. Miller, research assistant, entomology (3/88)

in parking lot areas. *Clover mites* occur as periodic pests of lawns and as a nuisance pest when they move into homes.

Most spider mites overwinter as the adult stage, hidden in protected areas such as in bark cracks or under debris around gardens. During this dormant stage many mites turn a bright red color, leading to their name "red spider" mites.

As temperatures warm the mites become active and begin to feed. Spider mites develop in relation to temperature; during warm periods they may become full grown in as little as a week. Full-grown females can produce over a dozen eggs per day for 1 to 2 weeks. The fast development rate and high egg production can often lead to extremely rapid increases in mite populations.

Hot, dry conditions are often associated with spider mite outbreaks, for several reasons. Most mites feed more in hot weather, which accelerates their development and egg production. Dry conditions may inhibit the effectiveness of spider mites' natural enemies, that are often less adapted to harsh conditions. Finally, water stressed plants do not tolerate mite feeding injury well.

Clover mites differ from other spider mites by being a "cool-season" species that occur in peak numbers during spring and autumn. At high temperatures, when other spider mites become active, clover mites produce dormant eggs.

Control

Spider mites are fed upon by a wide variety of organisms that often provide a high level of natural control. One of the more common of these **biological controls** is a very small species of black ladybird beetle, the spider mite destroyer (*Stethorus*), that only feeds on spider mites. Also important are various predator mites (*Amblysieus* and others) that feed upon mite eggs and young spider mites. Minute pirate bugs and predatory thrips are among the other natural mite controls.

One common reason for spider mite outbreaks in yards and gardens is the use of insecticides that destroy mite predators. Carbaryl (Sevin) is devastating to the natural controls and can greatly contribute to mite outbreaks. Malathion, an insecticide that often lists control claims for spider mites, also is damaging to spider mite biological controls and can aggravate mite problems.

Various forms of **water management** also can assist in spider mite management. Adequate watering of plants during dry conditions can limit the importance of drought stress on spider mite outbreaks. Periodic hosing of plants with a forceful jet of water, directed at the leaf undersides, also can be useful in spider mite control. Hosing can physically remove and kill many mites as well as remove the dust that collects on foliage and interferes with mite predators. Disruption of the webbing also may delay egg-laying until new webbing is produced.

Spider mite control on house plants can be a particularly frustrating activity. When attempting controls, all susceptible houseplants should be treated at the same time. Heavily infested leaves can be trimmed, bagged and removed. Severely infested plants should often be discarded entirely. Small plants can then be hosed in the sink or shower. Leaves of larger plants can be wiped with a soft damp cloth. These treatments generally need to be reapplied at 1 to 2 week intervals until mite populations are eliminated.

Chemical controls of spider mites generally involve pesticides specifically developed for spider mite control (miticides/acaricides). Few insecticides are effective for spider mite control. Regardless of the pesticide used, mite control can be difficult since resistance to pesticides is widespread, particularly among the two-spotted spider mites.

Table 1: Characteristics of common spider mite pesticides.

Common name	Trade names	Remarks
dicofol	Kelthane, Isotox, Insect Killer, Red Spider Spray	A long-time standard for mite control, found in a wide variety of products. Production was temporarily suspended in 1986-87 but has been reinstated with improved manufacture. Reduced effectiveness at high temperatures.
soap	Safers Insecticidal Soap, Aphid-Mite Attack	Causes injury to some plants. Generally safe to use and is harmless to most natural enemies. No residual effect.
sulfur	various	Also sold for control of some fungus diseases. Plant injury may occur if used during high temperatures.
dienochlor	Pentac	A specific miticide. Not available in small packages.
avermectin	Avid	Highly effective miticide that has recently become available for greenhouse uses. Mites stop feeding shortly after treatment but may not die for several days.
acephate	Orthene, Isotox	An insecticide with some effectiveness against spider mites. Isotox is currently an acephate/dicofol mix.
dimethoate	Cygon	Availability limited to certain evergreen sprays. An insecticide with some activity against spider mites.
hexakis	Vendex	A specific miticide. Not available in small packages. Reduced effectiveness at high temperatures.

Carefully read and follow all label instructions before purchase and use of spider mite sprays. Also note that most spider mite pesticides can only be used on landscape plants and are not for use on fruit and vegetable crops.

service in ACTION

Colorado State University Cooperative Extension

no. 2.937

Cytospora canker

W. R. Jacobi[1]

Quick Facts

- Cytospora canker occurs on woody plants or parts of plants that are in a weakened or stressed condition.
- Many trees are affected by this disease including aspen, birch, cottonwood, poplar, spruce, willow, ash, maple, elm, peach and apple.
- Disease management includes practices that reduce stress on trees, utilize resistant plants, remove infected limbs, clean wounds and follow proper pruning techniques.

Cytospora canker is caused by various species of the fungus *Cytospora*. These pathogens affect many species of trees in Colorado including aspen, cottonwood, lombardy and other poplars, apple, cherry, peach, plums, birch, willow, honeylocust, mountain ash, silver maple, spruce and Siberian elm.

The fungus attacks trees or parts of trees that are injured or in a weakened or stressed condition and may cause their death. Trees affected by drought, insects, defoliation by a fungi, sunscald, herbicides, or mechanical injury are susceptible to cytospora infection. The disease especially damages trees with root damage, which often are found in areas under construction, or trees that have been recently transplanted. Stands of aspen that have been thinned and young aspen sprout stands may suffer from cytospora canker.

Symptoms

The symptoms of this disease are yellow or orange-brown to black discolored areas on the bark of the trunk and branches (Figure 1). Oozing of liquid on aspen and oozing of gums on peach and cherry are common. Cankers, sunken dead areas of bark with black pinhead-sized speckling or pimples, may be evident (Figure 2). The pimples are the reproductive structures (pycnidia) of the fungus. Under moist conditions, masses of spores (seeds) may ooze out of the pimples in long, orange, coiled, thread-like spore tendrils (Figure 3). Reddish brown discoloration of the wood and inner bark also may be evident. Dead bark may remain attached to the tree for several years, then fall off in large pieces.

On spruce trees, the disease appears as sunken areas surrounded by swollen callus giving a gall-like appearance. Small black pimples (pycnidia) may occur on the canker. Once the branch is girdled, needles may yellow or redden with eventual death of the branch. Large amounts of resin flow from infected areas, coating branches and stems. Unless you see sunken areas surrounded by swollen callus, resin flow on spruce may indicate other stresses, diseases, or insects are affecting the tree.

Control

Since this canker usually occurs on a weakened host, the first and foremost method of control is to prevent infection by preventing stress on the tree. To help a tree resist infection prepare soil before planting, fertilize, water properly for winter and summer, prune (see Service in Action sheet 2.932 *Environmental disorders of woody plants*), and avoid injury to the trunk and limbs. Proper care of recently transplanted trees also is essential to avoid stress and infection (see 7.213 *Care and maintenance of large transplanted trees*). Wounds caused by lawnmowers and weed eaters are prime targets for infection on trees in landscaped areas. Insects (such as oyster-shell scale) stress the tree and predispose it to cytospora infection and should be controlled.

Prevention of cankers at pruning wounds on peach and cherry trees is helped by Benlate or Mertect 340F wound dressings. The effectiveness of fungicides on other trees is not known but research on other diseases indicates effectiveness is probably limited. For further information on diseases and controls, especially on fruit trees, see the Colorado State University Cooperative Extension publications, *Colorado Tree Fruit Pest Management Guide* and *Ornamental and Turf Spray Guide*.

[1]*W. R. Jacobi, Colorado State University associate professor, plant pathology and weed science (Revised 12/88)*

Another way to prevent cytospora damage is to use resistant species or varieties in new plantings (Table 1). Remember, resistant does not mean the plant is immune, just better able to defend itself against the pathogen than some other tree. You still need to keep all trees healthy. Purchasing healthy nursery stock will decrease the possibility of infection.

Once infection occurs, the best treatment is to increase plant vigor and sanitation. Remove all infected limbs and other areas. When removing branches, make a smooth cut at the base of the limb, as near the trunk as possible, without damaging the branch collar (swollen area at base of branch). Jagged and rough cut surfaces promote infection. (See 7.003, *Training and pruning fruit trees in the home garden*, 7.206, *Pruning techniques for shrubs* and 7.207, *Pruning deciduous trees.)*

Wounds should be cleaned to avoid further spread of infection. Remove dead bark to dry out the diseased area and help the tree defend itself against insect and fungal attacks on the cankered area. Directions for proper wound and canker treatment are as follows:

1. Prune or cut trees only during dry weather.
2. Clean tools and wipe them with ethyl alcohol, Lysol or other disinfectant. Clorox may be used at a concentration of 1 part Clorox to 9 parts water.
3. If a wound is fresh (one month or less) use a sharp knife to **carefully** cut and remove all injured or diseased bark back to live, healthy tissue. If the wound is older, just remove loose bark pieces. It is important **not** to cut, remove or damage callus that may be forming at the canker edge. Callus will look like swollen bark growing across the dead area. Scrape the wound surface clean of loose bark.
4. Tools should be cleaned and disinfected after each cut.
5. Cleaned wounds should not have any sharp angles.
6. Do not apply any tar or oil-based paint, or other wound dressing. The best method to prevent infection or decay is to allow the cleaned tissue to dry out.

Table 1: Some resistant species and cultivars.

Pines
Junipers
Ash—all cultivars
Hackberry
Honeylocust—all cultivars
Lindens—big and little leaf
Maples—most species and cultivars
Elms
Cottonwood—cultivars *(Noreaster, Platte, Mighty Mo, Ohio Red)*
Aspen—resistant cultivars not commercially available
(Avoid Lombardy, Bolleana, Sioux Land Cottonwoods)

Figure 1: Orange discoloration, found in spring and early summer, associated with cytospora canker on aspen.

Figure 2: Cytospora canker with black pycnidia.

Figure 3: Orange spores oozing from pycnidia of cytospora.

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COLORADO STATE UNIVERSITY EXTENSION SERVICE

Juniper-hawthorn rust

Lester E. Dickens[1/]

no. 2.904

Quick Facts

- Juniper-hawthorn rust must have primary and alternate hosts to complete its life cycle.
- Junipers are the primary hosts.
- Hawthorn, apple, crab apple and mountain ash are alternate hosts.
- Untreated infections cause premature defoliation, reduced yields and death of the tree.
- Fungicides applied to both primary and alternate hosts at two-week intervals throughout the season provide good protection.

Juniper-hawthorn rust is a fungus infection which produces galls on juniper (cedar) trees and leaf spots and fruit infections on alternate hosts—hawthorn, apple, crab apple and mountain ash.

The disease is caused by the fungus *Gymnosporangium betheli*. Infections cause reduced fruit size and premature defoliation. Defoliated trees may suffer winter injury and often fail to set fruit the following season. Continued infections over a period of years weaken trees and render them unproductive. Young trees in nurseries and orchards may die because of defoliation.

Life Cycle

Rust galls on junipers become active in early spring following rainy weather. The active galls consist of gelatinous, yellow spore horns that eject billions of spores as they dry. These are carried by the wind to the alternate hosts.

Alternate hosts, infected by the spores, develop light yellow spots on the upper surfaces of the leaves. These develop into pustules of light brown spores on the underside of leaves later in the summer. The spores are then wind-borne to susceptible juniper trees.

Infections take place and juniper galls develop the following year. The spore stage on juniper cannot reinfect juniper but must go to an alternate host. Likewise, the spore stage on the alternate host cannot reinfect that host but must go to juniper in order to complete the life cycle.

Natural Control

Landscapes should be designed so that susceptible junipers are separated as far as possible from alternate hosts. Where practical, the house or a dense hedge should be located between junipers and alternate hosts.

The rust depends on two hosts to complete its life cycle. It cannot survive in the absence of one of the hosts.

Juniper galls should be removed to lessen the chance of infection of alternate hosts.

In the spring, when the gelatinous spore horns emerge from the juniper galls, the first protective spray to alternate hosts can be applied.

Chemical Control

Fungicide sprays:

- Dithane M-22 Special
- Dithane M-45
- Dithane Z-78
- Manzate
- Manzate D
- Manzate 200

Follow label directions.

Time of Application

Alternate hosts such as hawthorn, apple, crab apple, and mountain ash may be sprayed at 7- to 10-day intervals beginning at blossom time. Follow label directions on chemical sprays.

[1/] *Lester E. Dickens, CSU extension professor, plant pathology (revised 1/1/79)*

Life Cycle of Juniper-Hawthorn Rust

Spores infect juniper.

Pustules on underside of hawthorn leaf.

Pustules on underside of leaves.

Galls form on branches.

Yellow spots on upper side of leaves.

Alternate host

Juniper

Dormant period

Yellow spore horns become active.

Rust galls on juniper.

Remove galls by pruning.

Inactive rust gall on juniper.

Start fungicide applications on hawthorn or other alternate hosts at bloom time.

service in ACTION

Colorado State University Cooperative Extension

no. 5.529

Pine tip moths:

characteristics and control

Whitney S. Cranshaw[1]

Quick Facts

- Tip moths are caterpillars that feed on and kill back new growth of various pines.
- Damage by tip moths is conspicuous but rarely threatens tree health.
- The southwestern pine tip moth that commonly infests Scots, ponderosa and mugho pines is best controlled with insecticides applied as new needles are elongating.
- Tip moths on pinyon overwinter in or on the terminal growth of the tree.

Pine tip moths feed on and destroy new growth (terminals) of pines grown throughout most of Colorado. Injury often is quite conspicuous and infested plants may appear unattractive. Although little real injury to the health of the infested tree results from pine tip moth attacks, tree growth can be delayed and the form altered to a more bushy growth.

Tip moth injury can be diagnosed during early to midsummer by examining suspect shoots that have dried and shriveled. At this time the damaging stage of the insect, or old discarded skins left behind, can be detected. If the insect is not present examine the damaged terminal growth to see if there is evidence of internal tunneling typical of most tip moth injuries.

Insects Involved

The southwestern pine tip moth, *Rhyacionia neomexicana*, is the species mainly responsible for damage to young ponderosa, mugho and Scots pines. Other tip moths in the same genus (*R. bushnelli, R. zozana, R. fumosana*) are found in the state but are much less common and damaging than the southwestern pine tip moth.

A different set of tip moths infests pinyon pine. Tip moths in the genus *Dioryctria* (primarily *D. albovitella*) damage pinyon in a manner typical of other tip moths, although it often is associated with a pinkish mash of pitch. Damage by other species, the pinyon pitch nodule moth (*Petrova arizonensis*), is more distinctive and produces a large, smooth nodule of purple-brown pitch as it feeds on pinyon terminals.

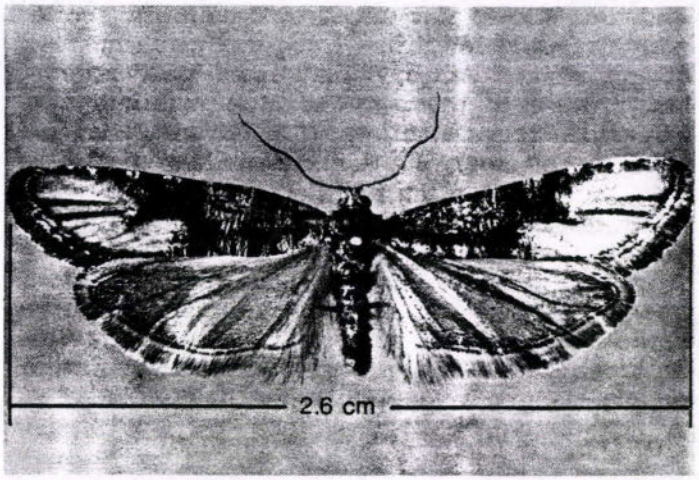


Figure 1: Southwestern pine tip moth adult, *Rhyacionia neomexicana.*

Life History

Pine tip moths have typical moth life histories, passing through four life stages—egg, larva/caterpillar, pupa and adult moth. It is the feeding of the larval stage that damages the trees. New infestations originate with eggs laid by the adult female moths, one generation per year.

[1]*Whitney S. Cranshaw, Colorado State University Cooperative Extension specialist and assistant professor, entomology (3/88)*

Eggs of the southwestern pine tip moth are laid on buds and new shoots of pines in the spring, April and May. Eggs hatch about the time new shoots emerge from buds and the tiny larvae immediately begin to bore into the fresh young shoot tissue. The larvae feed and grow within the developing shoots through May, June and July causing tip growth to die back beyond the feeding site.

When feeding is completed, the full-grown caterpillar leaves the shoot to crawl down the trunk. On the side of the trunk just below the soil line it forms a white, plaster-like silken cocoon for pupating. Winter is spent in this stage with adult moths of the southwestern pine tip moth emerging the following spring on return of warm weather.

Tip moths infesting pinyon overwinter as partially grown larvae either in stem tissue or on the bark. Eggs of the common tip moth (*D. albovitella*) are laid during mid-summer. The larvae emerge shortly afterwards but do not feed, instead they form a silken cocoon (hibernacula) on the bark for the winter. The larvae resume activity in May, boring into the base of unopened buds. Often the larvae will destroy the initially infested bud and move to a new shoot or developing cone, which it will also mine. Irregular pitch masses often form at the injury site, superficially resembling those of the pinyon pitch nodule moth. Pupation occurs within the infested area, with the adult moths emerging to mate and lay eggs.

The pinyon pitch nodule moth lays eggs on the base of needles during early summer, after the new growth has formed. Eggs hatch by early August and the young caterpillars tunnel into a new shoot. While feeding they form a distinctive smooth silk-lined pitch nodule and spend the winter as an almost full-grown caterpillar. Pupation occurs wedged in an opening in the nodule.

Control

Numerous natural enemies of tip moths exist that often reduce infestations to acceptable levels. In particular, various parasitic wasps develop within tip moth larvae killing a large percentage of the population. As a result of these natural controls, tip moth infestations can vary widely from season to season. Trees taller than 10 feet often become less susceptible to tip moth injuries.

If necessary, tip moths can be controlled with insecticides. The systemic insecticides acephate (Orthene) and dimethoate (Cygon) appear to be particularly effective for tip moth control. Chlorpyrifos (Dursban) also is effective for pine tip moth control. Proper timing of these sprays is very important. Treatments for the southwestern pine tip moth should be applied when new shoots are elongating but before the needles are more than 1/2 inch in length ("candling stage"). For most pines this typically occurs from late April through early May.

Figure 2: Tip damage from larvae of pinyon pine tip moths.

Figure 3: Stage of shoot elongation to apply insecticide treatment for southwestern pine tip moth control.

Treatment timing for the pinyon tip moths are less well known. Thorough insecticide treatment in May should be effective if applied to new growth before overwintering *Dioryctria* larvae enter buds. Somewhat later treatments can still be effective at killing larvae moving from buds to developing shoots. Mid-summer applications coinciding with egg laying in late July appear to be most appropriate for pitch nodule moth control.

service in ACTION

Colorado State University Cooperative Extension

no. 7.226

Care of young transplanted trees

James R. Feucht[1]

Quick Facts

- Late March to mid-April is the best time of year to plant trees.
- A vigorous root system, important in establishing new transplants, can be favored by watering to a depth of 12 to 18 inches (30 to 46 centimeters) below the soil surface.
- Mulching around the transplant's base will reduce soil moisture loss, improve water and air penetration into the soil, and keep soil temperature above freezing longer in the fall.
- Young transplants are susceptible to sunscald injury during winter and early spring.
- Selective removal of crowded, interfering or weak branches is the only pruning that should be done at planting time.
- Top-heavy trees and evergreens with high wind resistance may need to be guyed.

Proper soil preparation before a tree is transplanted often means the difference between success and failure. Soil preparation promotes favorable growing conditions by improving soil drainage and reducing compaction problems. For more information on soil preparation, see Service in Action sheet 7.222, *Soil—the key to successful gardening.*

Planting trees in early spring will help insure their survival during the first year. Soil temperatures in late March to mid-April are warm enough for root growth to occur, firmly anchoring the tree in its new environment. This early root growth is important to the tree since foliage development and warmer, drier weather will demand considerable amounts of water from the newly established root system. Trees planted in the fall are often subject to low survival if a cold spell occurs early. This is because roots need to become established before the drying, cold conditions common in winter. If fall planting is a must, do so no later than mid-October (see Service in Action sheet 7.417, *How to plant trees and shrubs).*

Transpiration occurs throughout the year, but the amount of water lost increases dramatically with foliage growth. Moisture stress often occurs in summer-planted trees because the tree transpires more water than the unestablished root system is capable of absorbing. Severe moisture stress weakens the tree and can even cause its death.

Proper Watering

Trees require water, but **improper** watering practices can cause more harm than good. Overwatering, a main cause of transplant failure, forces oxygen out of the soil and results in oxygen starvation of roots. This causes death of roots and leads to an eventual decline of the tree. The yellowing of foliage, developing first low and inside on the tree and progressing to the outer leaves, is an indication of oxygen starvation. Frequent light waterings should be avoided. This practice promotes shallow root systems susceptible to dessication in winter and heat stress in summer.

Timing of watering should be determined by the moisture level of the soil just above the root zone—the area containing most of the tree's feeder roots, generally six to ten inches (15-25 centimeters) below the soil surface. Dig down six to eight inches (15-20 cm) at the edge of the planting hole. If the soil at that depth feels powdery or crumbles when squeezed in your hand, the tree should be watered; soil that forms a ball and clings together when squeezed contains adequate moisture. By using the digging method to determine soil mois-

[1]*James F. Feucht, Colorado State University Cooperative Extension specialist, landscape plants (revised 4/87)*

when foliage is not in direct sun. Late afternoon is the best time.

Time-release packets designed to be placed in the planting hole often release nutrients too slowly and do not give good nutrient distribution. They also tend to continue to release nitrogen late in the summer, encouraging succulent growth susceptible to winter injury. Tree spikes do not give good distribution of nutrients in Colorado's heavy clay soils.

Sunscald Prevention

With the exception of birch and aspen, young transplants and thin-barked trees, especially those planted on the south side of buildings, are susceptible to an injury called "sunscald" during the winter and early spring. The surface temperature of trees is elevated above that of the surrounding air by the absorption of sunlight. This rise in surface temperature occurs long enough to make cells in the bark active and thus vulnerable to injury during the sudden nighttime temperature drop.

Wrapping the tree trunk with a commercial crepe wrap will reduce the heating effect leading to sunscald damage because light will be reflected rather than absorbed. Starting at the base of the trunk, overlap the wrap as it is wound upward. Secure the top end with a single staple or small tack. The wrap should be placed on the tree from November through April for maximum protection, then removed during spring and summer to prevent harboring insect and disease organisms.

Pruning

Selective removal of crowded, interfering or weak branches is the only pruning that should be done at planting time. Nutrients necessary to support future growth are stored in branches, therefore indiscriminate pruning depletes the tree's food reserves. Pruning also reduces the amount of foliage the tree has to produce food needed for growth during the growing season.

Avoid pruning back from branch tips. Pruning this way will alter the tree's natural shape and remove the buds that produce the strongest growth. Tip pruning also tends to stimulate weak sucker growth or "water sprouts." Pruning cuts should not be painted, because paint will increase wound drying time and promote disease development on the cut. For more information on recommended pruning methods, see Service in Action sheet 7.207, *Pruning deciduous shade trees.*

Guying

Trees that are top-heavy or have high wind resistance, such as evergreens, may need to be guyed until the end of the second season to prevent wind throw. Guy wires or ropes should be attached through grommets at the ends of any strong, soft, wide strips of material to avoid girdling injury. **Do not use wire through garden hose.** Indoor-outdoor carpet cut in strips three to four inches (8 to 10 cm) wide, or webbed strapping like that used in backpacks is suitable. Place guying traps around tree **below** the midpoint. Wires or ropes should have a slight sag to allow for natural sway, but not so loose that the tree can uproot (see Figure 2).

Proper care can prevent injury to any tree. Take care of your new trees so you won't have to start over next year replacing transplant failures.

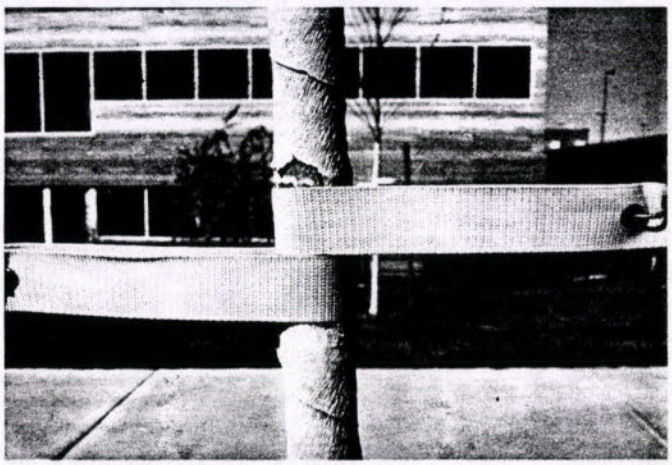
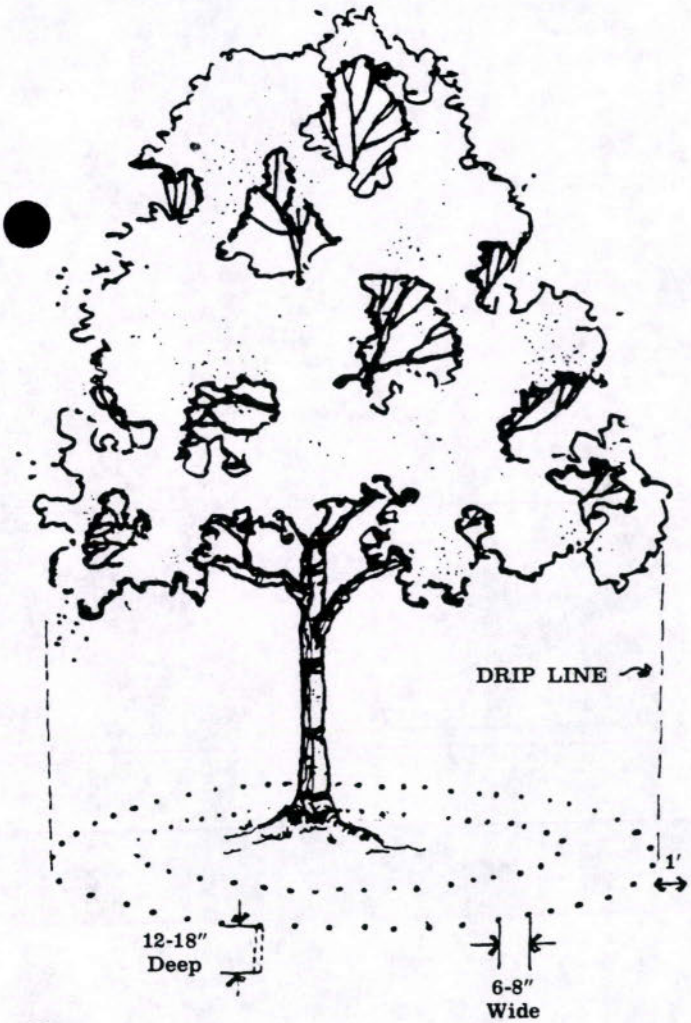


Figure 2: Guy wires should be attached through grommets at ends of strong, soft fabric to avoid girdling a tree. *Do not use wire through garden hose.*

ture, a watering schedule for your situation should become evident. Adhering to this schedule with compensation for natural precipitation, will then eliminate the need to continually check moisture level by digging.

A vigorous root system, important in establishing new transplants, can be favored by deep watering—watering to a depth of 12 to 18 inches (30-46 cm) below the soil surface. A commonly used method of deep watering is flooding the soil surface until water eventually soaks down to the desired depth. However, flooding is wasteful of water and temporarily drives oxygen out of the soil, smothering tree roots. Placing water at the proper depth initially is a more efficient way to deep water.

A soil needle or root feeder garden hose attachment will release water under pressure at the correct depth without causing oxygen starvation problems. The area halfway between the trunk and the outer stretch of the branches, out to approximately one foot beyond the "drip line" (directly below the branch extremities) is the area to be watered. Use the soil needle in a zigzag pattern around the tree to be sure all the feeder roots receive adequate moisture; the more needle insertions the better. The needle should be inserted to a depth of 12-18 inches, left in place for 30 to 60 seconds, then moved a distance of six to eight inches (15-20 cm) (see Figure 1). After the entire root system is watered, the procedure should be repeated with the needle slanted slightly away from the tree. First and second year balled-and-burlapped trees will benefit from inserting the root feeder directly into the original root ball during each watering. **Caution:** Reduce water pressure when inserting soil needle into root ball or near backfill.



Art by Carey Orwig, Kansas State

Figure 1: Proper root watering for young transplanted trees.

Extended dry periods, especially in fall and winter, may cause atmospheric humidity and soil moisture to drop below required levels for shallow-rooted trees. The result of this drying is injury or death to roots. Winter watering will prevent drying damage by replenishing soil moisture levels. Water early in the day when temperatures are above freezing and use a soil needle to avoid problems getting the water to soak in by nightfall. (Refer also to Service In Action sheet 7.211 *Fall and winter watering*).

Mulching around the transplant's base will reduce soil moisture loss, improve water and air penetration into the soil, and keep soil temperature above freezing longer in the fall. These conditions are conducive to root growth and therefore will improve tree vigor. Wood chips, shredded bark, dried grass clippings or pine needles all can be used for mulch. Cover the area dug up during transplanting with a mulch to about a 5-inch depth. Avoid mounding mulch next to tree trunk.

Fertilizers

Because soils in Colorado usually contain adequate nutrient reserves, fertilizer applications are seldom necessary until the second year after transplanting. Consult your local Colorado State University Cooperative Extension office for assistance in obtaining a soil test to determine nutritional needs.

For best results, fertilizing should be done once in the spring after leafing. There are several methods for applying fertilizer to the tree. The easiest and most economical method of fertilizing is broadcasting, or simply spreading the material under the tree as you would on the lawn. This method should be followed by a thorough watering to carry the minerals to the root zone. **Warning:** The quantity of fertilizer required by established trees can burn lawns if broadcast in a single application. In these cases it is best to apply the recommended amount in several partial applications.

Mild solutions of fertilizer can also be applied directly to foliage. **Use only products formulated and labeled for "foliar feeding."** To avoid burn, follow dilution rates on label carefully and apply

SERVICE IN ACTION
COLORADO STATE UNIVERSITY EXTENSION SERVICE

Slime flux of trees

Lester E. Dickens[1/]

no. 2.910

Quick Facts

- Slime flux is a malodorous, slimy mass of fermenting sap exuded from tree wounds.
- Injuries to a tree resulting in the exudation of a large amount of sap are excellent sites for bacterial invasion.
- The bacterial and other microbial organisms cause fermentation of the sap.
- Slime flux prevents healing of wounds, and is toxic to the cambium of the tree.
- Treatment consists of providing proper drainage of the fluxing wound, repair of the injury and treatment of exposed healthy tissue to prevent bacterial reinvasion.

Slime flux is a malodorous, slimy mass of bacteria-infested, fermenting sap that exudes from a tree wound and flows down the trunk. The bark has a wet appearance. When dry, the flux leaves a light gray incrustation on the bark.

Slime flux prevents healing of wounds and is toxic to the cambium—the tissue between the inner bark and the wood. The cambium produces all secondary growth in plants and is vital to the life of the tree.

Slime flux gets its name from the exuding sap or fluxing that begins with excessive bleeding. The flux affects various shade trees but occurs primarily on elm, maple, poplar and willow.

Exudations of sap arise from injuries on the trunk, large limbs and crotches of the tree. The injury usually is a pruning wound or crack in the wood. Such injuries with their exuding sap are favorite places for bacteria and various other microbes to multiply and cause fermentation.

Treatment

Slime flux may be treated by boring a hole slanted upward below the fluxing wound into which is fitted a drain pipe (see Figures 1 & 2). This allows the flux to escape without injuring the cambium or causing an unsightly accumulation on the bark. A container should be used to collect the flux so that it does not drip onto the base of the tree.

After the fluxing has been relieved, the affected tissue should be scraped out and the bark cut back to healthy tissue. (For information on pruning deciduous trees, see Service in Action sheet 7.207.) Cutting tools should be cleaned after using.

The healthy tissue should be swabbed with 70 percent ethyl alcohol and a light coat of orange shellac or other wound dressing applied after cutting the affected wood. Wounds should be repainted once or twice a year until they have healed.

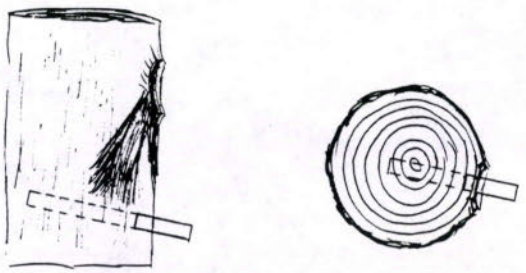


Figure 1: Pruning wounds that have not healed properly may flux. A drain pipe inserted a short way into the sapwood will drain off toxic flux that may accumulate. The drain hole may be bored 8 to 12 inches (20.3 to 30.5 centimeters) below the wound at an upward angle.

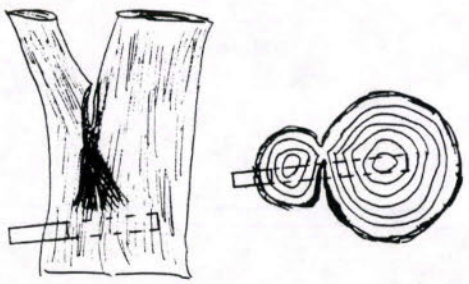


Figure 2: Sharp angle crotches may tend to split and later fluxing develops. A drain pipe may be used. The injury should be cleaned. Such branches can be supported with eye-screws and connecting cable to prevent splitting in the crotch.

[1/] *Lester E. Dickens, CSU extension professor, plant pathology (revised 9/1/79)*

Colorado State Forest Service

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80523

FIREWOOD FACT SHEET

Firewood units of measure:

- 1 cord = wood properly stacked measuring 4 feet x 4 feet x 8 feet.
- 1 cord = 128 cubic feet including air spaces or 75-90 cubic feet of solid wood as influenced by the size and stacking of the wood.
- Face cord is not a legal unit of measurement for sale in Colorado. Firewood may also be sold by cubic measure or weight. When buying by weight, buy only dry wood.

When cutting your own firewood, the following guides may help in determining the cords cut:

- Six 11-inch diameter trees measured at ground level are needed to make a cord. This naturally varies with tree height and size of branches. Number of trees per cord varies with diameter. Smaller diameters require more trees to make a cord.
- A rounded, unstacked load of unsplit wood in the back of a standard fleetside pickup is about 1/2 cord.

Firewood Characteristics

	* Range lbs./cord	Approximate BTU per pound	Splits	Sparks
Aspen	1995-2394	8,400	easy	few
Cottonwood	1837-2205	8,300	hard	few
Douglas Fir	2617-3141	9,200	easy	moderate
Lodgepole	2152-2583	8,600	easy	moderate
Oak	3562-4275	8,400	hard	few
Pinyon	3000-3600	11,100	hard	many
Ponderosa	2100-2520	9,100	easy	moderate
Spruce	1837-2205	8,100	easy	many

* Weight figured at 12 percent moisture content for air dried wood. Ranges calculated using 75 cubic feet solid wood/cord for poorly stacked wood with large bark to 90 cubic feet solid wood/cord for well stacked wood with little bark.