

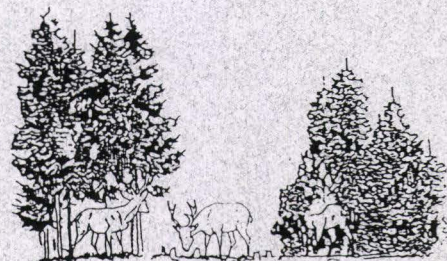
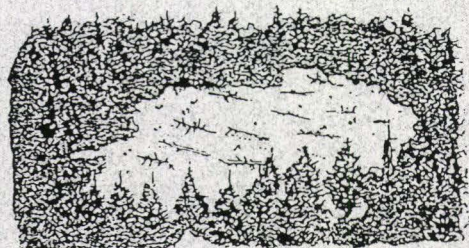
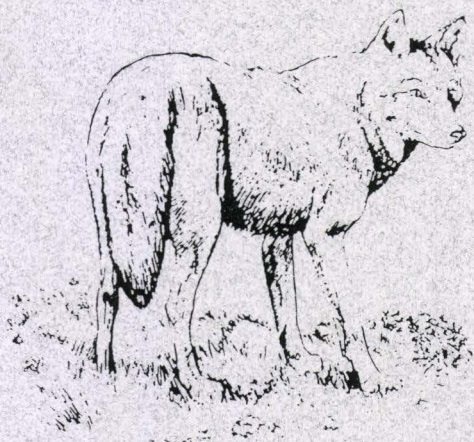
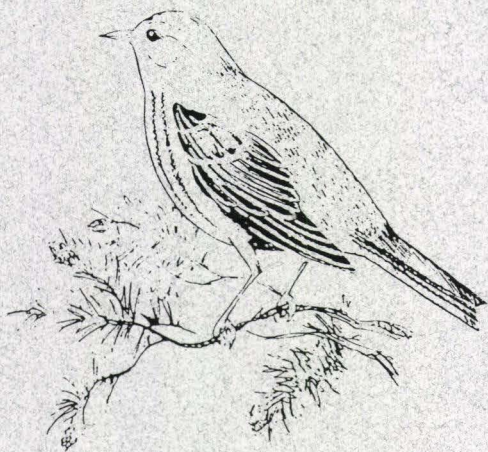
2310

MANHATTAN SECTION

M. 1/2 SEC. 16 T. 9 N. R. 3 W.

MANHATTAN SECTION

Forest Management Plan



Forest Management Plan

For The

Manhattan Section

West 1/2, Section 16, T.9N., R.73W., Sixth Principle Meridian

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Colorado State Forest Service
Fort Collins District

January, 1992

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Statement of Purpose

The primary purpose of this forest management plan is to develop a scheme for managing the Manhattan section owned by the State Land Board. A important objective is to provide direction for raising revenue from forest products. Any forest management activity must be accomplished in a way that protects the productivity of the land and other forest resources. In order to simplify this plan the Manhattan section will be called "the section" throughout this project.

Property Description

Location

The Manhattan section is located along the front range of the Rocky Mountains in northern Colorado. It sits approximately 4 miles south of Red Feather Lakes and 3 miles north of the town of Rustic. This area is 35 miles northwest of Fort Collins (see the regional and local maps on the following pages).

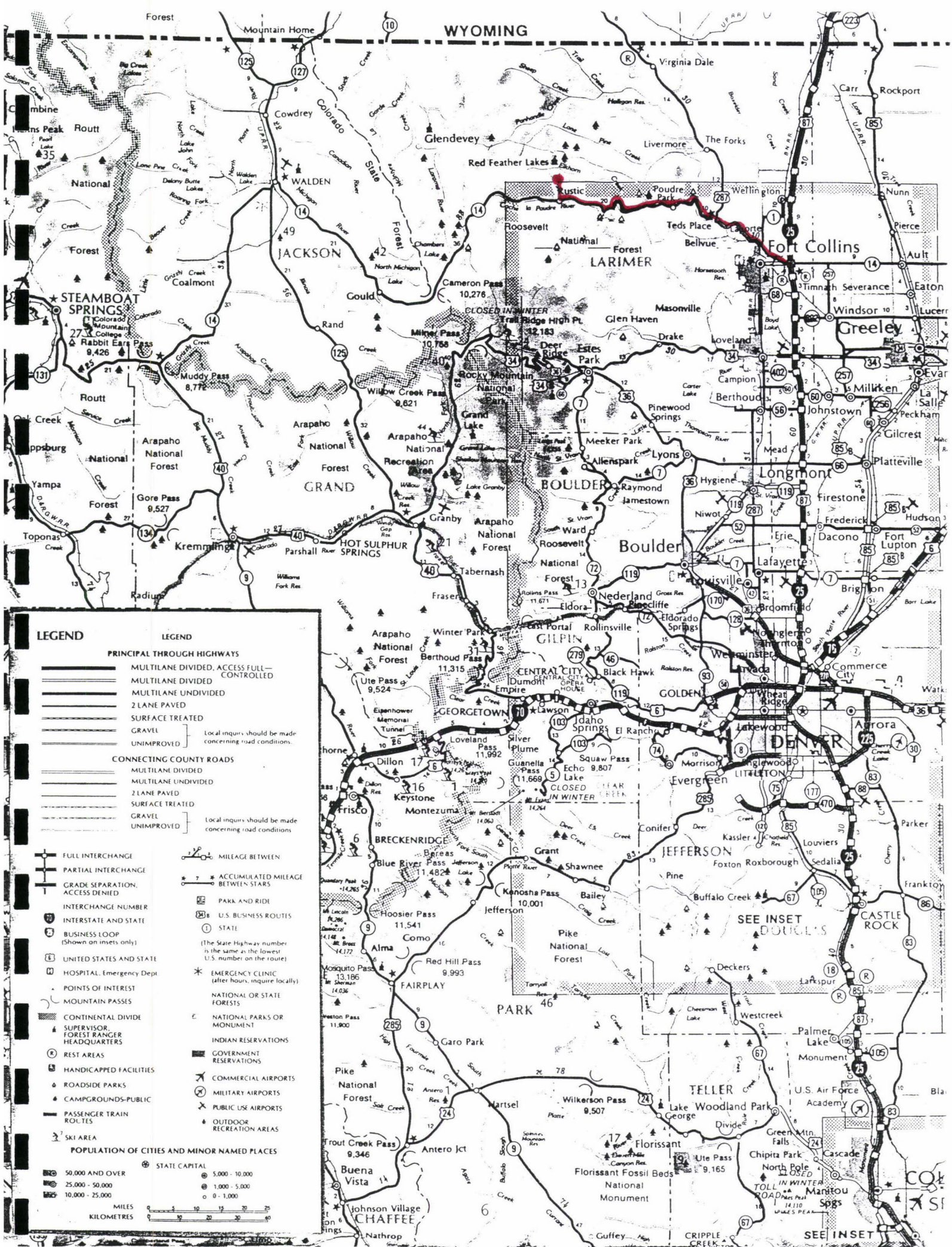
The section is located in the center of the Roosevelt National Forest. It is bordered on the west and north sides by U.S. forest service lands. The south and east sides of the section are bordered by private lands.

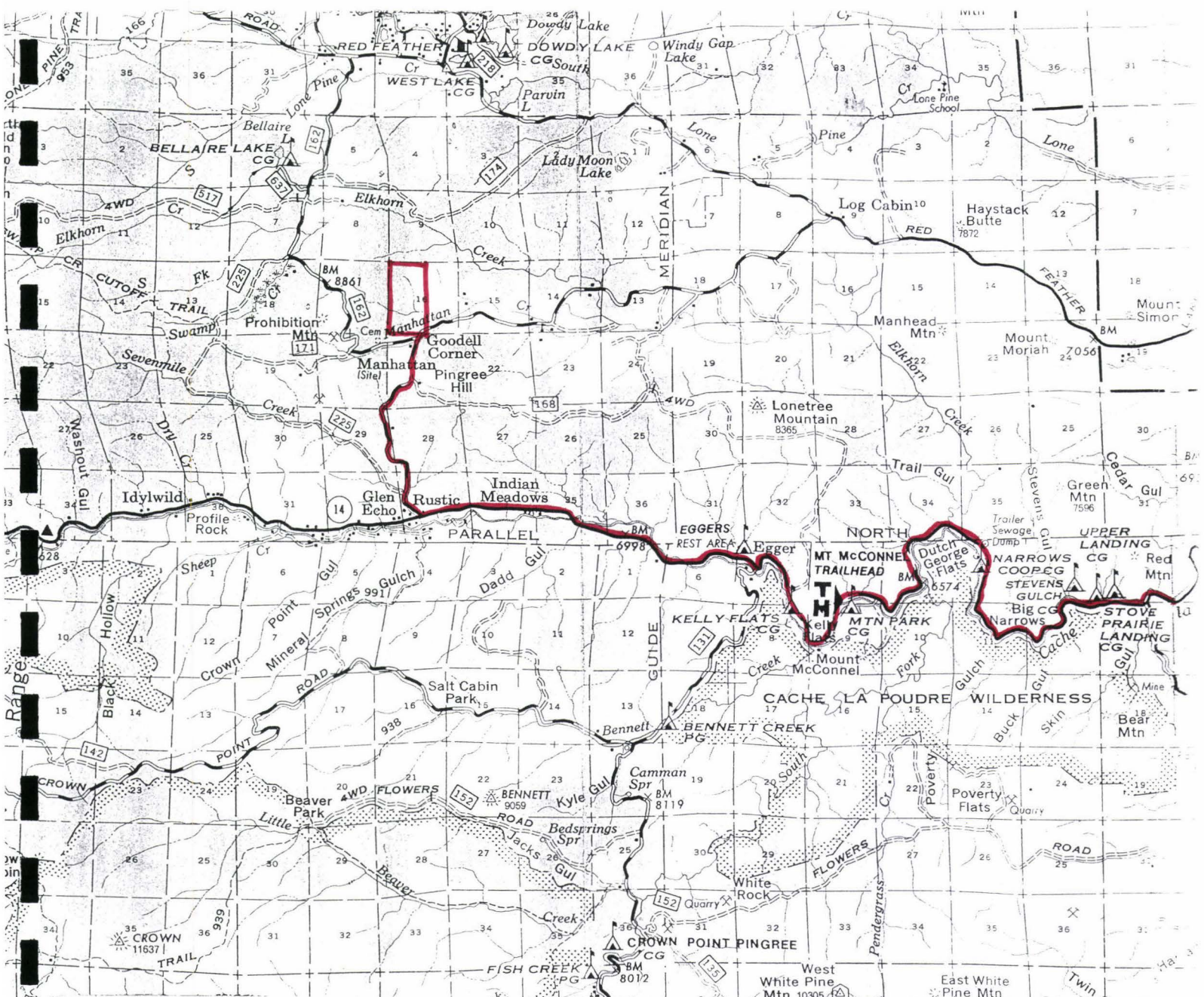
History

The land around the section is rich in history. The area was created during a period of mountain building known as the Laramide Orogeny. Glaciers left evidence of their existence throughout the area, scouring the land with moraines and depressions.

Before recorded history, the Arapaho and Cheyenne Indians utilized the area hunting and gathering wild plants. Fur trappers worked the local streams, possibly Manhattan Creek, in search of pelts during the 1800's to 1850's. In the mid-1800's prospectors searched the streams for gold and other valuable minerals.

The section has a history of timber activities. During the late-1800's lumberjacks who supplied ties to the railroad entered the region in search of suitable timber. It appears that some of the larger and older timber was harvested at this time from the



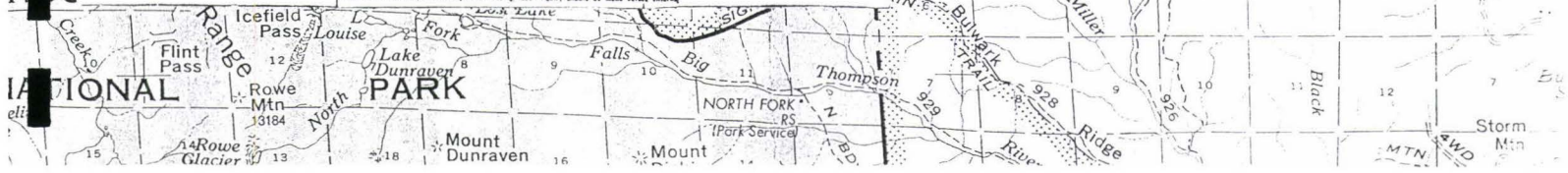


U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
R. MAX PETERSON 1912
ROOSEVELT NATIONAL FOREST
COLORADO
SIXTH PRINCIPAL MERIDIAN



- LEGEND**
- | | |
|---|---|
| — National Forest Boundary | ▲ Forest Supervisors Headquarters |
| - - - Adjacent National Forest Boundary | ○ District Ranger Station |
| — State Boundary Line | — Forest Service Station |
| - - - County Boundary Line | ● Recreation Site |
| — Reservation Boundary | ● Recreation Site other than Forest Service |
| — Wilderness Boundary | — Ski Area |
| — Interstate Highway | ▲ Observation Site |
| — U.S. Highway | ● Point of Interest |
| — State Highway | — House, Cabin or other Building |
| — Forest Road | — Water Well |
| — Paved Road | — Mine, Quarry or Gravel Pit |
| — All Weather Road | — Roosevelt National Forest Land |
| — Dirt Road | — Adjacent National Forest Land |
| — Prohibited Road and Four Wheel Drive Road | — BLM Land |
| — Trail | — State Land (permission required to enter) |
| — Railroad Tunnel | — National Park or Monument Land |
| — Dam | — Land owned by other bodies of land |
| | — National Recreation Area |

Public lands are subject to changes and having local inquiries should be made before entering



section. There is also evidence of logging at a later date. Slab piles, the edges of the logs when cut to boards, are found in the flat drainage bottoms indicating that a portable sawmill used here. Old stumps can be found throughout several of the easily accessible stands.

The section was probably involved with the large fires which burned most of the region in the 1890's. There are fire scars on many of the older trees. It is highly probable that there has been more recent smaller wildfires. In any case the section has a proven history of fire occurrence.

The section is presently under control of the State Land Board. Their purpose is to generate revenue of the states schools. They have asked the Colorado State Forest Service for assistance with timber related activities.

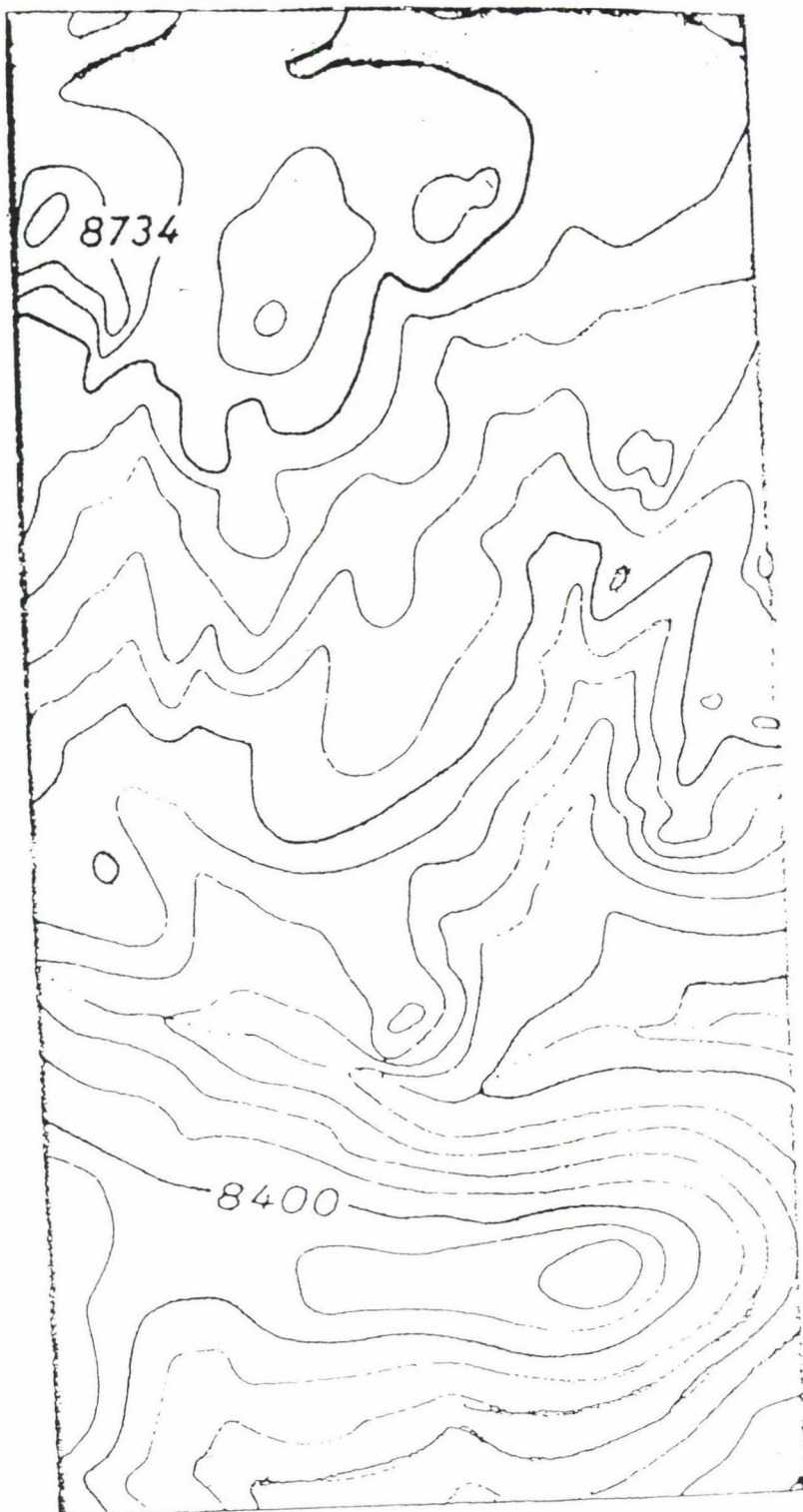
Topography

The elevation ranges from 8734' at the highest point of the ridgeline on the north side of the section, to 8150' at the lowest point where the intermittent stream crosses the boundary line.

The section has two major ridgelines one already discussed to the north and one on the south side of the section. These ridgelines can be quite steep and rocky in areas. This limits access in certain portions of these sites. These ridgelines create two different microclimates, one on the north slopes and the other on the south slopes. These different microclimates create unique tree growing conditions and understory plants. See the topographic map on the following page.

West 1/2, Sec. 16, T.9N., R.73W.

TOPOGRAPHIC MAP



Scale: 4" = .5 mile

The intermittent stream is the next major topographic feature. This small stream feeds the manhattan creek which intern feeds the Poudre River. The riparian bottom provides a moist microclimte increasing the diversity of the section.

Soils

There are 5 soil types found on the section. These soil types correspond with the topography and vegetation types. The 2 dominant soil types are the Wetmore-Boyle-Moen complex and the Wetmore-Boyle-Rock outcrop complex. These shallow soils are formed from weathered granite resulting in a low water holding capacity. The vegetation found on these soils are ponderosa pine and Douglas fir with a grass or brush understory.

The second major soil type is the Redfeather sandy loam. This soil type is shallow, well drained and was formed from weathered granite. The vegetation found on this soil type is lodgepole pine, spruce, and aspen with a grass understory.

There are 2 minor soil types found on the section, the Haploborolls-Rock Outcrop Complex and the Breece coarse sandy loam. These soil types are mainly found in the nonforested areas of the section. These soils are best suited for limited grazing, wildlife, and watershed. A detail description along with a map can be found in Appendix A.

Access

A majority of the section is accessible by motorized vehicle. This is due to the established roads and jeep trails that run through the section. There is easy access is through private land on the east side of the section. To use this road will require permission from the new land owner. There is possible access through 2 points on U.S. Forest Service lands. U. S. Forest Service road 162 lies to the west of the section, from this road 2 small unimproved roads head towards the section. The first connects into a previous USFS timber sale next to the west boundary of the section. The second road goes by the northwest section corner marker Access into the section does not appear be a problem, though crossing USFS lands will increase road costs.

There are several stands (5, 7 & 1) in which access is for the most part limited to foot. This is because of steep slopes or rock outcrops. See the section access map on the following page.

Wildlife

No formal inventory of wildlife was made but visual observations were made during the timber inventory. The section provides the basic needs of most wildlife, food, water, and cover. A detailed description of wildlife management can be found in Appendix B. Mule deer and elk sign (rubs, beds, and scat) were commonly seen throughout the section. This region is known by many for its healthy elk population and trophy Mule deer.

The pine squirrel is the most common animal species found on the section, this is due to the abundant food source (pine cones).

West 1/2, Sec. 16, T.9N., R.73W.

ACCESS MAP

New Power Line

USFS
old harvest
unit

Private

U.S. Forest 162

Roads not to scale.

Scale: 4" = .5 mile

The porcupine is another inhabitant of the area, these animals feed on tree bark and small branches. This will usually kill or damage the tree, but these animals usually do not damage a entire forest. Other small rodents and birds can also be found throughout the section. The section appears to have a healthy and diverse wildlife population. No endangered plant or animal species are known to be found on the section.

When implementing any type of forest management practice it is wise to leave a few older and dead trees in the harvest unit for wildlife snags. These trees provide homes for cavity nesters and food for animals like woodpeckers. A detailed description of the guidelines for snag retention is found in Appendix B.

Wildfire

The section has a history of fire occurrence which has already been discussed. The species which we wish to manage has evolved by adapting to fire. Early white man tried to excluded fire from the ecosystem, today it is known that fire plays an important role in the shaping of each ecosystem. The exclusion of fire has created rather high fuel loadings which increases the fire potential. This potential can be decreased by good forest management and prescribed burning. The guidelines for prescribed burning and slash disposal in Larimer county can be found in Appendix C.

The section falls into 2 fuel models using the fuel models established by the National Wildfire Coordinating Group. The first is fuel model 2, which is characterized by a light grass under ponderosa pine. This fuel type burned fairly frequently in the

past. Prescribed burning this fuel type would promote nutrient recycling and increase the forage production. The second fuel type found on the section is fuel model 8. This fuel model is represented by a closed canopy with a compact litter layer for the understory. Generally a wildfire within this fuel type is a slow burning surface fire with occasional pockets of heavy fuels that can flare up. Every 100 to 300 years weather conditions (wind, temperatures, and relative humidities) become right to result in a crown fire.

The excellent access into the section should assist firefighters with wildfire suppression. The intermittent stream and the pond on the southern portion of the section should be noted as reliable water sources for either prescribed burning or suppression activities.

Scenic and Cultural Resources

No known archeological sites exist on the section. The slab piles in the openings and fence lines along the ridges should be protected for historical reasons.

The Red Feather area is a highly used year round recreation area, any type of forest management activity must be sensitive to this fact. The view from the top of north ridge is quiet spectacular, providing a unique panorama from Wyoming to Rocky Mountain National Park.

Insects

At the present time no major insect problems exist on the section. There are 2 dominant pest of the region, the mountain pine beetle (Dendroctonus ponderosa) and the western spruce budworm (Choristoneura occidentalis). A detailed description of these pest can be found in Appendix D. These insects usually attack the forest in cycles, every 20 to 40 years outbreaks can occur. They usually are attracted to the older more stressed trees of the forest. This is a natural process, providing the forest a natural way to rejuvenate itself. The damage can be mitigated by good forest management and a tree destine to die can become a useful product.

Diseases

The most serious disease of the region is dwarf mistletoe (Arceuthobium americanum). At the present time there is very little mistletoe found on the section. Though there are places around the Redfeather area which are severely infected. This parasitic plant gets nutrients from the tree, severely weakening the tree. This makes the tree more susceptible to other pest problems and results in a loss of growth.

The second most common diseases of the region are the Western gall rust (Peridermium larknesii) and commandra blister rust (Cronartium commandrae). This disease is only a minor problem and will not decimate the entire forest. A detailed description of these diseases can be found in Appendix D.

Timber

The timber inventory was conducted throughout the section during the fall of 1991. This was done on a stand basis, requiring the separation of similar tree species and tree densities into management units (see the stand map on the following page). Each stand was then inventoried with small random plots to determine the characteristics and a estimate of the volume. The data collected at each plot were tree diameter, tree height, dominant tree age, regeneration, wildlife observations, wildfire history, and insect and disease occurrence.

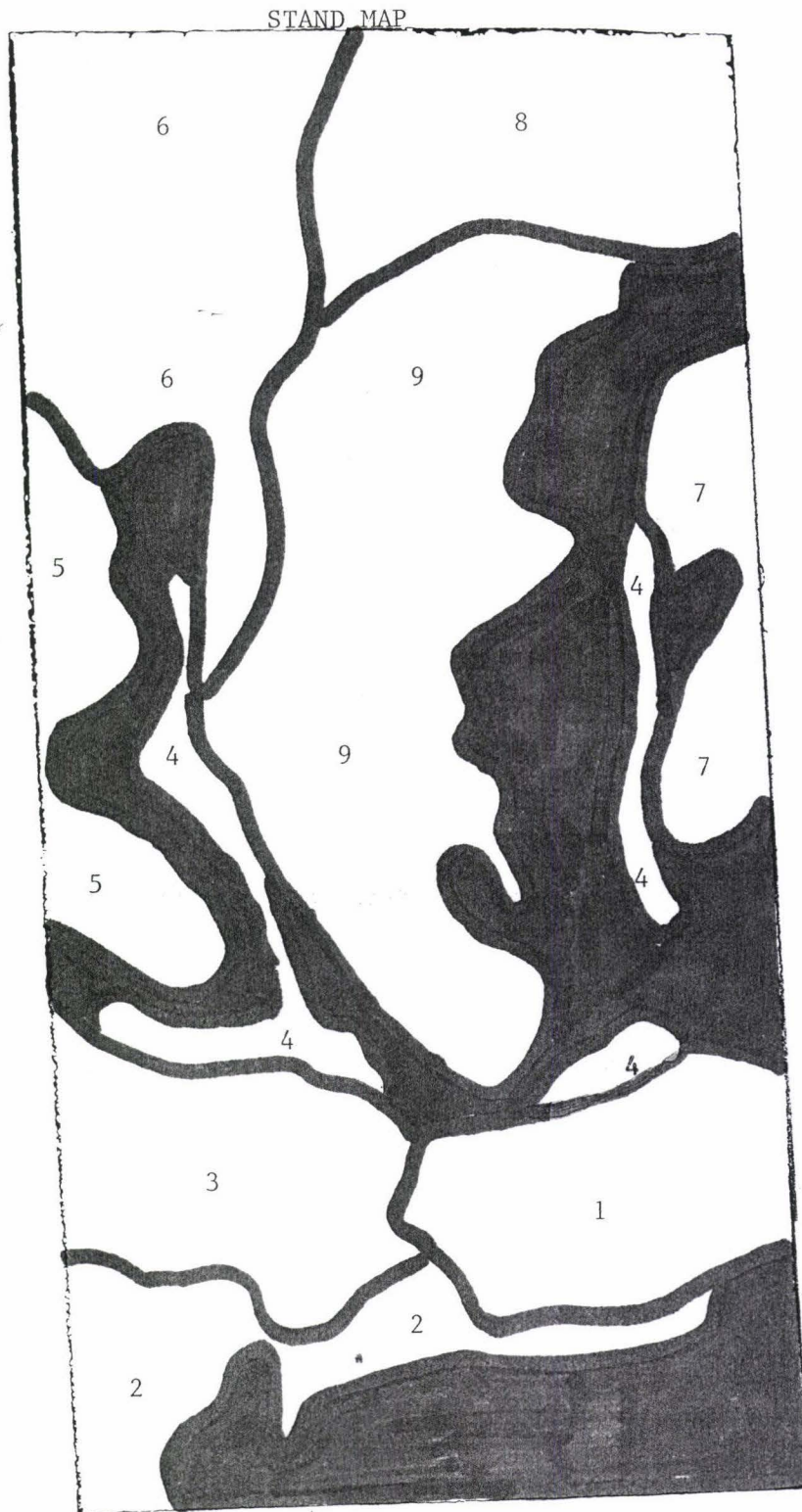
The timber information was then run through a computer program to set up the stand and stock tables, see **Appendix E**. The stand and stock tables are used to give us an estimate of the volume of timber in each stand.

The dominant tree species found on the section is ponderosa pine (Pinus ponderosa). Colorado Front Range ponderosa pine is one of the most important timber species of the region. The tree species dominates the dryer southern aspects of the section, but is also found in the mixed conifer stands on the north aspects.

The second most common tree species on the section is Lodgepole pine (Pinus contorta). This is another important timber products species. Small pockets of pure lodgepole pine can be found, but a majority of the tree species is mixed with other conifers.

There are several other tree species found on the section, though less common than the two species listed above. Douglas fir (Pseudotsuga menziesii) and Limber pine (Pinus flexilis) can be

West 1/2, Sec. 16, T.9N., R.73W.



■ = Meadow

1 = Stand 1

Scale : 4" = .5 mile

found occasionally mixed in with the lodgepole and ponderosa pine stands. Aspen (Populus tremuloides), Subalpine fir (Abies lasiocarpa), Engelmann spruce (Picea engelmanni) are found in the riparian bottom along the intermittent stream. A in depth description of each species can be found in Appendix F.

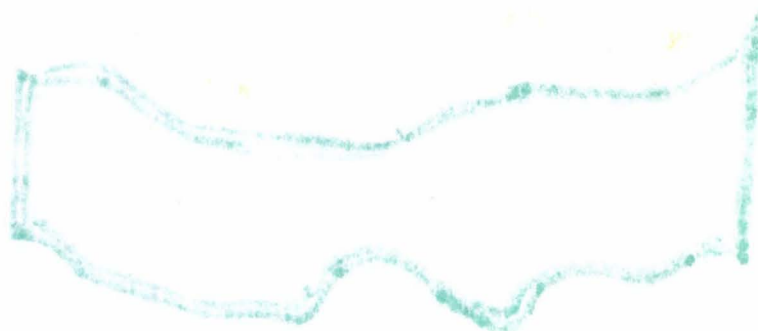
It is important to know the forest cover type when managing a section of land. See the map illustrated on the following page. This map corresponds closely the stand and soils maps which have already been presented.

West 1/2, Sec. 16, T.9N., R.73W.

VEGETATION TYPE MAP



Scale : 4" = .5 mile



Stand Description

Below each management unit (stand) is described in detail in the following layout.

The top line of each stand description describes the stand number, acreage and the trees per acre (TPA).

- A) Species, average size and height.
- B) Stand stocking level and regeneration.
- C) Forest products.
- D) Insect and disease problems.
- E) Miscellaneous information.

Recommendation or management alternatives.

These management alternatives will be discussed in detail in the following section.

STAND 1 23.5 acres, TPA - 498.

- A) Lodgepole and ponderosa pine, Douglas-fir --- Ave. DBH-8, HT-50.
 - B) Overstocked (BA 164) --- Excellent regeneration 300 per acre.
 - C) Sawtimber, posts and pole, houselogs, shakes and fuelwood.
 - D) Slight mistletoe present.
 - E) Steep slopes (40% +), limited access, wildlife usage.
- Recommendations 1,2,3,4,7 & 9 possible.

STAND 2 20.5 acres, TPA - 58.

- A) Ponderosa pine --- Ave. DBH-11, HT-30.
 - B) Understocked (BA 40) --- Poor regeneration 33 per acre.
 - C) Sawtimber and fuelwood.
 - D)
 - E) Wind exposed stunted trees, limited access, slopes 20 - 30%.
- Recommendations 4,7 & 9 possible.

STAND 3 23 acres, TPA - 482.

- A) Lodgepole and ponderosa pine, Douglas-fir --- Ave. DBH-7, HT-50.
 - B) Overstocked (BA 144) --- Good regeneration 125 per acre.
 - C) Sawtimber, posts and pole, houselogs, shakes and fuelwood.
 - D) Mountain pine beetle and rust present.
 - E) Slopes less than 20%, possible good access, wildlife usage.
- Recommendations 1,2,4,5,7,8 & 9 probable.

STAND 4 14 acres, TPA - 411.

- A) Aspen --- Ave. DBH-8, HT-40.
- B) Wellstocked (BA 135) --- Excellent regeneration.
- C) Fuelwood and transplants.
- D) Conks present in older trees.
- E) High plant diversity, wildlife usage, easy access and minimal slopes.

Recommendations 5,7 & 9 probable.

STAND 5 16.5 acres, TPA - 176.

- A) Ponderosa pine --- Ave. DBH-10, HT-40.
- B) Wellstocked (BA 105) --- Fair regeneration 75 per acre.
- C) Sawlogs and fuelwood.
- D) Rust present.
- E) Limited access due to rocky slopes (12%), wildlife usage.

Recommendations 1,4,7 & 9 possible.

STAND 6 49 acres, TPA - 314.

- A) Lodgepole and ponderosa pine --- Ave. DBH-9, HT-50.
- B) Wellstocked (BA 133) --- Good regeneration 130 per acre.
- C) Sawlogs, posts and pole, houselogs, shakes and fuelwood.
- D) Mountain pine beetle and rust present.
- E) Good access from stand 8, Average slope 10%, wildlife usage.

Recommendations 1,2,5,7,8, & 9 probable.

STAND 7 16 acres, TPA - 263.

- A) Douglas-fir and ponderosa pine --- Ave DBH-9, HT-40.
- B) Wellstocked (BA 117) --- Poor regeneration 33 per acre.
- C) Sawlogs, houselogs and fuelwood.
- D)

- E) Very rocky steep slopes, limited access.

Recommendations 4,7 & 9 possible.

STAND 8 27.5 acres, TPA - 338.

- A) Ponderosa and lodgepole pine --- Ave. DBH-8, HT-40.
- B) Wellstocked (BA 126) --- Fair regeneration 100 per acre.
- C) Sawlogs, posts and pole, houselogs, shakes and fuelwood.
- D) Rust and mountain pine beetle present.
- E) Excellent access, Ave slope 12%, wildlife usage.

Recommendations 1,2,7,8, & 9 probable.

STAND 9 61.5 acres, TPA - 377.

- A) Ponderosa pine --- Ave. DBH-8, HT-40.
- B) Wellstocked (BA 128) --- Fair regeneration 50 per acre.
- C) Sawlogs and fuelwood.
- D) Rust present.

- E) Excellent access - road through stand, Ave slopes 15%.

Recommendations 1,2,4,5,7,8 & 9 probable.

Meadow (Nonforest area) 68.5 acres.

Native Grasses - good condition.

Livestock and wildlife forage.

Recommendations - Burn periodically to promote new growth and nutrient recycling.

Recommendations

After each stand description there is 1 or more recommendation numbers. These numbers correspond to the forest management practices listed on the following pages. A detailed description of each of these practices along with the optimal growing stock levels can be found in Appendix G. Each recommendation is followed by the word probable or possible. This represents if the activity is feasible at this time. This is based on slope, access and economics. A stand may need management such as thinning but the possibility of the activity being carried out may be slim due to economic factors. The possible recommendations are based on the idea that things may change in the future. The price of timber may go up, roads may be improved or extended, or an insect or disease problem may make a recommendation feasible. No action is also a possible management alternative decision, preserving the area for wildlife or aesthetics are valid alternatives.

This plan lays the foundation for land management. In order to implement any of the recommendations a professional forester must come up with each activity plan. At the end of this section is a review of the stand recommendations.

(1)

Thin to Growing Stock Level (GSL) 80

Thinning the stand to a growing stock level of 80 means that the basal area (Appendix 4) is at 80.0 square feet per acre when the average stand diameter is 10.0 inches after thinning. Practically speaking, this yields an ideal spacing distance between the trees after thinning dependent on their average diameter. This enables the person thinning the stand to remove trees to optimize spacing at whatever size. By looking at the chart in Appendix 4 and determining what the average diameter of the stand is, an ideal distance between trees can be determined. For instance, an average diameter of 10.0 inches in a space between trees of 17.2 feet. During thinning, remove poorly shaped, damaged or diseased, and competing smaller trees. "Character trees", or trees with specific uses, such as wildlife snags, should be retained. Western gall rust infected trees should be discriminated against and removed during thinning as well (Appendix 3).

(2)

Thinning to Growing Stock Level (GSL) 100

This is similar to the previous thinning prescription, but to a slightly higher basal area. Distances between trees will be slightly less. Different sites may support, especially north facing slopes, and different species may require, Douglas-fir for example, a different spacing. Again, by looking at the chart in Appendix 4 and determining what the average diameter of the stand is, an ideal distance between trees can be determined. During thinning, remove poorly shaped, damaged or diseased, and competing smaller trees. "Character trees", or trees with specific uses, such as wildlife snags, should be retained. Western gall rust infected trees should be discriminated against and removed during thinning as well (Appendix 3).

(3)

Patch Cut to Sanitize Dwarf Mistletoe

Where patches of dwarf mistletoe occur, cut all infected trees within the infestation, to sanitize the stand (Appendix 3). These patch clearcuts should not exceed 5 acres in size for wildlife considerations. Patch cuts should be started on the outside of the infested areas, and proceed into the center of the infested areas. This prevents the further spread of this parasitic disease to uninfected trees outside the patch cut.

(4)

Thin to Growing Stock Level (GSL) 80 where necessary

In stands with considerable variability in the stocking level, some patches of higher density may need to be thinned, while other areas of the stand may not need to be thinned. In fact, understocked areas within the stand adjacent to these higher density patches may need to be planted or regenerated. Thus, this recommendation indicates that thinning to GSL 80, as previously described, should be done when necessary.

Improvement Cut

The purpose of an improvement cut is to remove badly diseased, damaged, standing dead, and poorly shaped trees to reduce fire hazard, and improve the residual stand. Generally, these conditions will occur in stands that were heavily infested by mountain pine beetle or cutover during previous years. Frequently, the improvement cut may also serve as a salvage cut, and the stand may need to be replaced with seedlings or natural regeneration.

(6)

Replant or Reseed

This practice involves the establishment of new trees through planting of seedlings or natural regeneration. Generally, regeneration should be of the same trees present within the stand prior to management activities. However, in the case of patch cuts for dwarf mistletoe, or in stands where this disease is present and not under control, susceptible seedlings should not be established. In these cases, dwarf mistletoe-infested ponderosa pine can be underplanted with non-susceptible species like Douglas-fir or Rocky Mountain juniper prior to the complete removal and control of the infested trees. In other situations, natural regeneration from existing trees may be desired. In this case, suitable seedbeds must be present for seedling establishment (Appendix 2, 4).

(7)

Patch Cut

This is a variation of a clearcut regeneration system, where all the trees within an area are removed to establish a new, even-aged stand. In this case, the clearcuts should be designed as patches of not more than 10 acres (Appendix 4).

(8)

Shelterwood

The shelterwood regeneration system utilizes the existing stand to provide a seed source for the new stand. As the stand matures, it is thinned to improve seedling establishment in the protection of the old stand. After the new regeneration is present, the older stand is removed (Appendix 4).

(9)

Group Selection

The group selection system replaces the older stand by creating small openings within the existing stand, and using seeding in from adjacent trees to establish regeneration. This system differs from the patch clearcut system by having much smaller openings, which are partially shaded by the surrounding stand (Appendix 4).

Review of Stand Recommendations

Stand 1 --- 1,2,3,4,7 & 9

Stand 2 --- 4,7 & 9

Stand 3 --- 1,2,4,5,7,8 & 9

Stand 4 --- 5,7 & 9

Stand 5 --- 1,4,7 & 9

Stand 6 --- 1,2,5,7,8 & 9

Stand 7 --- 4,7 & 9

Stand 8 --- 1,2,7,8 & 9

Stand 9 --- 1,2,4,5,7,8 & 9

PRODUCT MARKET DESCRIPTION

There are many advantages to selling timber products from one's land. The obvious benefit is the revenue generated from these sales. With proper management, this revenue will provide a positive dollar return from the land, helping to pay for property taxes; and, most importantly, for past and subsequent forest management operations. One of the only ways to effectively manage timber is through harvesting portions of it. The revenue generated from timber product sales, after covering the cost of sale administration, is usually invested in prospective timber management. If properly conducted, this management will ensure a perpetual supply of quality timber and revenue. Forest management strives to use tree resources at a rate constant with their renewal and to harvest them in ways that ensure timely regeneration of future crops.

There is a wide variety of timber products available from the management area. Sawlogs, posts and poles, houselogs, shakes, fuelwood, Christmas trees, and transplants are the primary ones.

SAWTIMBER

Sawtimber may be sold on the stump to various local logging contractors and haulers. The U.S. Forest Service is currently selling its stumpage for about \$62 per thousand board feet (MBF). This is with average harvesting conditions, for the price fluctuates with factors such as hauling distance, skidding distance, temporary road construction, slash disposal, erosion control, and other requirements for the logging contractor. Each sawmill has different merchantability standards, but most require tree-length logs, cut down to a six-inch top diameter. Of course, defects in the logs (sweep, crook, rot, fire scars, excessive knots, etc.) will reduce their value when scaled at the mill. Sawmills will pay their logging contractors anywhere from \$70 to \$150/MBF.

Posts and Poles

Along with fuelwood, posts and poles are obtained primarily from thinning. The tree size of this raw material limits its use to posts and poles only, but there are many local mills that will take tree-length lodgepole pine for post and pole production. The Colorado State Forest Service sells post and pole stumpage to contractors for anywhere from \$5 to \$15 per cord. Again, this fluctuates with logging requirements. Mills usually accept tree-length lodgepole and require 2 1/2 to 3 inch top diameters. Mills generally measure posts and poles timber by the linear foot, and this ranges from \$.06 to \$.15 per linear foot.

Houselogs

Houselogs are a product that may be sold for a considerable profit. However, only the biggest and best are demanded. Mills generally require at least 30-foot logs with 7-inch minimum top diameters. Live or sound, standing dead

Engelmann spruce or lodgepole pine may be used. A logger might pay anywhere from \$10 to \$20 per log, but must be insured a full truckload to make it worth his while. Mills pay anywhere from \$.50 to \$1.50 per linear foot.

Shakes

Needmore Forest Products is unique because it is one of the few shake mills in the region. Needmore manufactures shakes exclusively from lodgepole pine, and pays its logging contractors around \$150/MBF. Logs must be eight-foot long minimum (with tree allowances) and have a minimum six-inch top diameter. This is a good market for medium-sized lodgepole pine. The stumpage price that the loggers pay will depend on the many logging constraints mentioned previously.

Fuelwood

Fuelwood is another very common product coming out of Colorado's Forests. There are a great deal of local fuelwood contractors that either sell their own wood, or sell to firewood suppliers. The Colorado State Forest Service charges anywhere from \$5 to \$15 per cord, depending upon logging requirements. Another option is to conduct a "public firewood sale" where the general public may cut their own wood and haul it out themselves. The usual price range for this type of sale is between \$5 and \$50 per cord, depending upon the distance these people have to travel. Firewood sales are an excellent way to clean up after a logging operation and generate some revenue also.

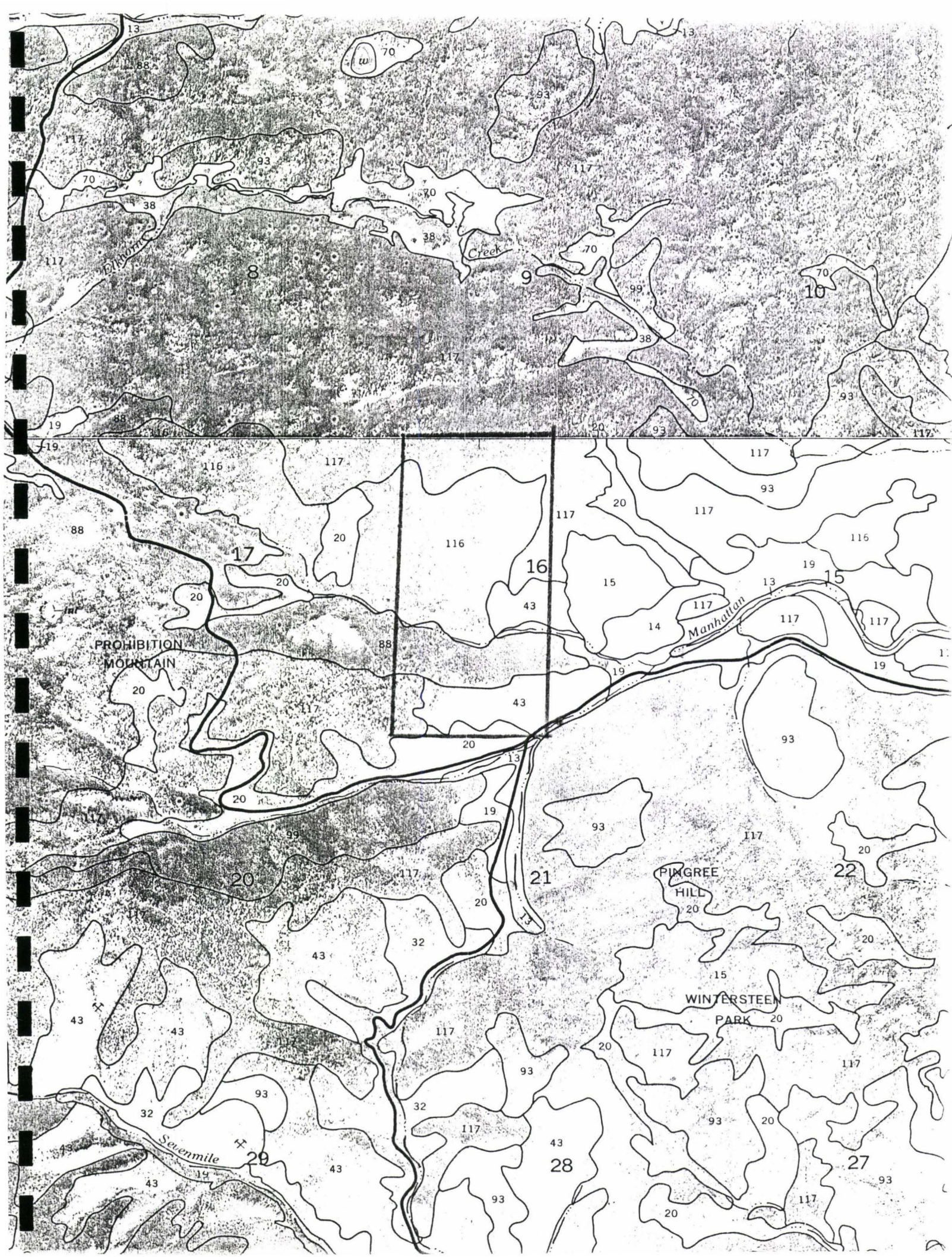
Christmas Trees and Transplants

The sale of Christmas trees and transplants is a good way to generate revenue if done correctly. Contractors may pay anywhere from \$4 to \$6 per Christmas tree (usually lodgepole pine, Douglas-fir, subalpine fir, and Engelmann spruce). The U.S. Forest Service and the Colorado State Forest Service have very successful public Christmas tree sales where \$6 to \$8 per tree is charged; the public cuts and hauls its own trees from the woods.

Small aspen transplants or "whips" are usually sold for around \$1 each, while larger (over six foot) aspen are sold for about \$3 each. Evergreen (usually lodgepole pine) transplants are sold from \$1 for small trees to \$3 for four-to five-foot trees, and sometimes \$2 per foot of tree. These are administered in contracts where trees are to be cut from a predetermined area.

APPENDIX A

SOILS INFORMATION



Wetmore Series

The Wetmore series consists of shallow, well drained soils that formed in material weathered from granite. These soils are on mountainsides and ridges and are underlain by granite bedrock at a depth of less than 20 inches. Elevation ranges from 6,500 to 8,000 feet. Slopes are 5 to 40 percent. The native vegetation is mainly ponderosa pine and Douglas fir and an understory of grasses and shrubs. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 42° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile a 2-inch-thick layer of organic material is on the surface. The surface layer is dark gray gravelly sandy loam about 2 inches thick. The subsurface layer is pinkish gray gravelly loamy sand about 3 inches thick. The subsoil is pinkish gray very gravelly loamy sand about 11 inches thick. Below this is granite bedrock.

Permeability is rapid, and the available water capacity is low. Reaction is slightly acid.

These soils are used mainly for forest and recreation. Some areas are used for grazing.

Representative profile of Wetmore gravelly sandy loam in an area of Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes, in forest, about 600 feet east of the southwest corner of sec. 13, T. 9 N., R. 73 W.:

- O1—2 inches to 0; partly decomposed needles, leaves, and twigs.
- A1—0 to 2 inches; dark gray (10YR 4/1) gravelly sandy loam, black (10YR 2/1) moist; weak fine granular structure; soft, very friable; 15 percent fine granitic gravel; slightly acid; abrupt smooth boundary.
- A2—2 to 5 inches; pinkish gray (7.5YR 6/2) gravelly loamy sand, dark brown (7.5YR 4/2) moist; weak thin platy structure; soft, very friable; about 15 percent fine granitic gravel; slightly acid; gradual wavy boundary.
- B2t—5 to 16 inches; pinkish gray (7.5YR 6/2) gravelly loamy sand, dark brown (7.5YR 4/2) moist; massive; slightly hard, very friable; seams and nodules of brown (7.5YR 4/3) light sandy clay loam embedded in material similar to that of the A2 horizon; some clay films bridging sand grains and on peds of sandy clay loam material; 40 percent gravel and stones; slightly acid; clear wavy boundary.

R—16 inches; granite bedrock.

The A horizon is sandy loam or loamy sand 0 to 3 inches thick. The B2t horizon is heavy sandy loam or sandy clay loam. It consists of lamellae about $\frac{1}{4}$ to $\frac{3}{4}$ inch thick imbedded in a matrix of loamy sand or light sandy loam. Content of rock fragments ranges from 35 to 60 percent in the B2t horizon. Depth to bedrock ranges from 8 to 20 inches. Reaction ranges from slightly acid to neutral.

116—Wetmore-Boyle-Moen complex, 5 to 40 percent slopes. This complex consists of strongly sloping to steep soils on mountainsides and ridges. It is about 35 percent Wetmore gravelly sandy loam, about 25 percent Boyle gravelly sandy loam, and about 25 percent Moen loam. The Wetmore soil is in forest. The Boyle soil is more sloping in grassed areas. The Moen soil is flatter in grassed areas.

Included with these soils in mapping is about 15 percent areas of Ratake and Trag soils and Rock outcrop.

Runoff is rapid, and the hazard of erosion is severe.

These soils are suited to native grasses and woodland. They are also used for recreation. Capability unit VIIc-1, dryland; Wetmore soil not assigned to a range site, Boyle soil in Rocky Loam range site, and Moen soil in Loamy Park range site; woodland suitability group 6d1; not assigned to a windbreak suitability group.

117—Wetmore-Boyle-Rock outcrop complex, 5 to 60 percent slopes. This complex consists of strongly sloping to very steep soils on mountainsides and ridges (fig. 13). It is about 35 percent Wetmore gravelly sandy loam, about 30 percent Boyle gravelly sandy loam, and about 25 percent Rock outcrop. Wetmore gravelly sandy loam is in forest, Boyle gravelly sandy loam is in open grassed areas, and Rock outcrop occurs throughout but is commonly near ridgetops and is steeper. The Wetmore soil has the profile described as representative of the Wetmore series. The Boyle soil

The Redfeather series consists of shallow, well drained soils that formed in material weathered from granite. These soils are on ridges and mountainsides and are underlain by granite bedrock at a depth of 10 to 20 inches. Elevation ranges from 8,500 to 9,500 feet. Slopes are 5 to 50 percent. The native vegetation is mainly forest of lodgepole pine, spruce, and some aspen and a thin understory of grass. Mean annual precipitation ranges from 15 to 20 inches, mean annual air temperature ranges from 40° to 44° F, and the frost-free season ranges from 60 to 85 days.

In a representative profile a 2-inch-thick layer of organic material is on the surface. The surface layer is dark grayish brown and light brownish gray sandy loam about 8 inches thick. The subsoil is brown gravelly sandy loam about 4 inches thick and reddish brown gravelly sandy clay loam about 5 inches thick. Below this is hard granite bedrock.

Permeability is moderately rapid, and the available water capacity is low. Reaction is medium acid above a depth of about 1 inch, strongly acid to a depth of about 12 inches, and medium acid below a depth of 12 inches.

These soils are used mainly for forest and recreation.

Representative profile of Redfeather sandy loam, 5 to 50 percent slopes, in forest, approximately 1,300 feet south and 1,000 feet west of the northeast corner of sec. 21, T. 11 N., R. 74 W.:

O1—2 inches to 1 inch; undecomposed organic material, mainly needles, bark, and twigs and remains of understory plants.

O2—1 inch to 0; partly decomposed organic material like that in the O1 horizon.

A1—0 to 1 inch; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable; noncalcareous; more than 10 percent gravel and stones; medium acid; clear smooth boundary.

A2—1 inch to 8 inches; light brownish gray (10YR 6/2) sandy loam, dark grayish

brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; about 15 percent gravel and stones; strongly acid; abrupt smooth boundary.

A&B—8 to 12 inches; brown (10YR 5/3) gravelly sandy loam, dark brown (10YR 4/3) moist; weak fine subangular blocky structure; soft, very friable; few patchy clay films on peds; about 30 percent gravel and stones; strongly acid; clear wavy boundary.

B2t—12 to 17 inches; reddish brown (5YR 5/4) gravelly sandy clay loam, dark reddish brown (5YR 3/4) moist; moderate fine and medium subangular blocky structure; slightly hard, firm; thin patchy clay films on peds; about 35 percent gravel and 10 percent cobbles; medium acid; gradual wavy boundary.

R—17 to 24 inches; hard granite bedrock.

The A1 horizon is sandy loam or gravelly sandy loam 1 inch to 3 inches thick. The A2 horizon is sandy loam or gravelly sandy loam 5 to 10 inches thick. The B2t horizon is gravelly or very gravelly sandy clay loam. Content of rock fragments, mainly fine granitic gravel and cobbles, in the solum ranges from 35 to 80 percent. Reaction ranges from strongly acid to slightly acid.

88—Redfeather sandy loam, 5 to 50 percent slopes. This strongly sloping to steep soil is on mountainsides and ridges.

Included with this soil in mapping are some small areas of shallow soils that have a darker colored surface layer. Also included are a few small areas of Schofield and Naz soils and areas of Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe.

This soil is suited to woodland and forestry purposes and to recreation. Some areas are used as sites for summer homes. Capability unit VIIe-1, dryland; woodland suitability group 6d2; not assigned to a range site or windbreak suitability group.

Haploborolls-Rock Outcrop Complex, Steep

43—Haploborolls-Rock outcrop complex, steep. This complex consists of steep and very steep, cool soils and

Rock outcrop on mountainsides and fans (fig. 8). The soils are extremely variable; about 50 to 70 percent of the unit, however, is stony and cobbly, dark colored soils that range from shallow to deep. These soils mainly have a surface layer and subsurface layer of sandy loam or loam that contain 10 to 25 percent cobbles and 20 to 35 percent stones. Stones that are on the surface are mainly boulders of granite, gneiss, and schist. About 30 to 50 percent of the mapped area is Rock outcrop. It is mainly on the steeper parts of the area, but it is scattered throughout.

Runoff is rapid, and the hazard of water erosion is severe.

These soils are used for a limited amount of grazing and are also used for wildlife habitat and watershed. Capability unit VIIe-1, dryland; Haploborolls in Stony Loam range site and Rock outcrop not assigned to a range site; not assigned to a windbreak suitability group.

Breece Series

The Breece series consists of deep, well drained soils that formed in alluvium, mainly from granite. These soils are on alluvial fans and valley side slopes. Elevation ranges from 6,800 to 7,800 feet. Slopes are 0 to 30 percent. The native vegetation is mainly needleand-thread, blue grama, junegrass, forbs, and a few scattered pine. Mean annual precipitation ranges from 15 to 18 inches, mean annual air temperature ranges from 44° to 46° F, and the frost-free season ranges from 75 to 100 days.

In a representative profile the surface layer is dark grayish brown coarse sandy loam about 18 inches thick over dark grayish brown gravelly coarse sandy loam about 18 inches thick. The underlying material is brown gravelly loamy coarse sand.

Permeability is rapid, and the available water capacity is medium. Reaction is neutral.

These soils are mainly used for native grasses. A few areas are used for irrigated hay.

Representative profile of Breece coarse sandy loam, 9 to 30 percent slopes, in native grass, about 0.1 mile east of the top of the hill and 0.3 mile northeast of the Forest Service sign on road at the edge of old borrow pit, in the SW $\frac{1}{4}$ sec. 10, T. 10 N., R. 71 W.:

A11—0 to 18 inches; dark grayish brown (10YR 4/2) coarse sandy loam, very dark gray-

ish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; 10 to 15 percent gravel; neutral; gradual wavy boundary.

A12—18 to 36 inches; dark grayish brown (10YR 4/2) gravelly coarse sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; soft, very friable; 25 percent gravel; neutral; gradual wavy boundary.

C—36 to 60 inches; brown (10YR 5/3) gravelly loamy coarse sand, brown (10YR 4/3) moist; massive; soft, very friable; 25 percent gravel; neutral.

The A horizon is sandy loam 20 to 55 inches thick. The C horizon is loamy sand or sandy loam. Reaction is slightly acid or neutral. Content of rock fragments, mainly fine granitic gravel, ranges from 0 to 35 percent.

19—Breece coarse sandy loam, 3 to 9 percent slopes. This gently sloping to strongly sloping soil is on terraces and in valleys. This soil has a profile similar to the one described as representative of the series, but the dark surface layer is about 40 inches thick.

Included with this soil in mapping are small areas of soils in which bedrock is at a depth of 40 to 60 inches and a few small areas of soils in which gravel is at a depth of 40 to 60 inches. Also included are a few scattered areas of Rock outcrop on steeper areas.

Runoff is medium, and the hazard of erosion is moderate.

This soil is suited to native grasses. Capability unit IVE-6, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

20—Breece coarse sandy loam, 9 to 30 percent slopes. This strongly sloping to steep soil is on terraces and valleysides. This soil has the profile described as representative of the series.

Included with this soil in mapping are small areas of soils that are more sloping or less sloping. Also included are areas of soils in which bedrock or a gravelly layer is at a depth of 20 to 60 inches and a few small areas of Rock outcrop.

Runoff is medium to rapid, and the hazard of erosion is severe.

This soil is suited to native grasses. Capability unit VIe-6, dryland; Loamy Park range site; not assigned to a windbreak suitability group.

APPENDIX B

WILDLIFE INFORMATION

SNAGS FOR WILDLIFE: MANAGEMENT GUIDELINES

Numerous species of birds and mammals are dependent upon snags and den trees during part of their life cycle. In addition, snag and den trees are used by large numbers of insects, fungi, plants, and animals. These trees are important components of the ecosystem and must be accommodated in forest management. The increased demand for fuelwood and other wood products in recent times underscores the concern for maintaining these trees as part of the wildlife habitat. Land managers and owners should be aware of the importance of providing snag and den trees for wildlife.

Snags are standing dead or partially dead trees, at least 6 inches in diameter at breast height (DBH) and 10 feet in height. Since large diameter snags meet the needs of many more wildlife species than smaller snags, value ratings of snags for wildlife are described below:

<u>Rating</u>	<u>Diameter</u>	<u>Height</u>
Excellent	20 inches plus	40-50+ feet
Good	15-19 inches	40-50+ feet
Fair	10-14 inches	15-40 feet
Poor	6-9 inches	10-20 feet

Den Trees are trees possessing a cavity large enough to serve as a shelter for birds and mammals, or as a den site to give birth and raise young. Den trees generally must be 15 inches DBH or larger and have a cavity opening of 4 inches in diameter or more. Snag Replacements are trees, such as a cull tree (of no commercial value), which is selected to be retained on the site to produce a future snag tree.

Providing a continuing supply of good to excellent quality snag and den trees, distributed over time of management and over the whole area of management, should be a goal on forestland. This distribution of snags and den trees is essential to maintain self-sustaining populations of all snag and cavity dependent wildlife species. In areas where good to excellent quality snag and den trees are lacking, poorer quality snags will have to be retained until larger diameter or taller trees develop. Some objectives for woodland managers and landowners to strive for in snag and den trees follow:

Den Trees

1. Managers should leave a minimum of one 15-inch or larger den tree per acre in all types of cuts.
2. Within 300 feet of bodies of water, at least two useful cavity trees per acre should be retained.
3. In addition, one tree per acre showing potential for development into a den tree should be retained.

Snag Trees

1. Retain a minimum of 4 excellent to good quality snags per acre. Den trees outlined above will serve as snag replacements.
2. Within 300 feet of openings and water, manage to provide 6 excellent to good quality snag trees per acre.

These recommendations are intended to help reach the goal of maintaining wildlife species dependent on snag and den trees. It may not be possible to have these den and snag trees evenly distributed over every acre. However, an even distribution over the entire management area is most desirable.

Adapted from: "Snags for Wildlife: Management Guidelines," by Doug Blodgett, in The American Tree Farmer Magazine, January-February, 1986.

WILDLIFE

Wildlife management is the art of applying scientifically derived ecological principles to achieve habitat and/or population goals (Bailey in press). Application of the wildlife management art on a particular unit of forested land requires the landowner or manager take the following steps:

1. Inventory wildlife species and their habitats;
2. Establish a management goal;
3. Develop a management plan which includes precise objectives for species and habitats to be managed, and management prescriptions, based on sound ecological principles, necessary to accomplish these objectives;
4. Implement the management plan; and
5. Monitor results and make necessary adjustments in management prescriptions to better achieve objectives.

Basically, any wildlife population is subjected to 2 types of factors: Those which contribute to its well-being, commonly called "welfare factors"; and those which contribute to its demise referred to as "decimating" factors." The major concern here is with the former.

Welfare factors necessary for existence of all vertebrate wildlife populations include food, cover, and water. Some species have additional needs, such as those for dusting, grit, salt, and nutrients. Collectively, the arrangement of these factors to meet the needs of a species constitutes the habitat of the species.

Each species is unique in its habitat requirements. Not only must its habitat provide places suitable for feeding, hiding, resting, sleeping, playing, and young rearing, these must be present in a combination, quality, and quantity needed by the species or individual. Furthermore, these welfare factors must occur within the daily activity pattern of the species.

Demand for some welfare factors varies with the season of the year; reproductive and winter periods are usually the most critical. More food is needed during both periods and protection from winter storms is a necessity for most species.

Welfare factors will be discussed separately in greater detail below:

FOOD--Food is essential to all organisms to provide energy needed for growth, maintenance of body processes, and reproduction. Each species through its evolutionary process, has developed adaptations that permit it to better utilize some foods than others. Often these adaptation are so specialized, such as beaks of some birds, that they limit the foods that can be utilized.

What foods are eaten by a species are determined by a number of factors, among which are: (1) what is present, (2) what is available, (3) what is needed physiologically by the consumer, and (4) the habits of the species, including skills in locating food items (Leopold 1933).

Several authorities have developed preference classes for foods used by different wildlife species (Leopold 1933, Giles 1978). Preference classes listed by Leopold include:

- (1) Preferred -- utilized as long as they last;
- (2) Staple -- Will maintain body weight;
- (3) Emergency -- will not maintain body weight and vitality over prolonged period; and
- (4) Stuffing -- consumed for bulk only, no nutritional value.

Palatability of food is a highly variable characteristic which may confuse the wildlife habitat manager. Leopold mentioned these variabilities:

- (1) Toxic foods which are avoided by experience;
- (2) Seasonal changes in chemical composition;
- (3) Geographical variations of forage species; and
- (4) Intraspecific differences between plants.

Availability of foods frequently determines their value to wildlife. Although not all factors determining food availability are subject to manipulation by the habitat manager, they must be considered in formulating overall habitat management programs in order to compensate for shortages. Leopold and Giles highlighted food availability problems; These included the following: being buried by snow or covered with sleet; being physically unavailable because of topographic features, such as cliffs, rivers, steep slopes, et cetera; and being unavailable because of man-made features, such as highways, fences, dams, et cetera.

Lastly, foods must also contain the necessary nutrients to sustain animals and provide for reproduction. While winter is usually the critical period for animal nutrition, several workers have pointed out the importance of nutrition to reproduction success in some species at other times of the year.

In order to provide the food requirements for the species of wildlife being managed, some knowledge of its food habits is needed. A basic reference on this subject is American Wildlife and Plants, A Guide to Wildlife Food Habits (Martin, Zim, and Nelson 1951).

COVER--In the commonly used sense, "cover" is something that protects an animal from the weather or its enemies, or provides places for it to rest, reproduce, and raise its young. Cover, depending upon the species and the circumstances, may be provided by plants, geomorphic structures, or topographical features.

Several attempts have been made to classify cover on a functional basis (Leopold 1933, USDA 1969, Scheffer 1974, Giles 1978). A composite list of these cover types with some changes in nomenclature include the following:

- (1) Escapement Cover -- used to escape man or predators;
- (2) Reproductive Cover -- used for breeding, nesting, young bearing, and rearing.
- (3) Resting and Loafing Cover -- used for sunning, preening, dusting, et cetera;

- (4) **Sleeping or Roosting Cover** -- used for more extensive periods than No. 3;
- (5) **Climatic Cover** -- used to escape the elements, rain, snow, sleet, cold, heat, and wind;
- (6) **Travel Cover** -- used to provide visual concealment when moving from one place to another; and
- (7) **Special Cover** -- includes cover requirements not needed by all species, such as for hibernation or molting.

Until recently, the cover requirements of forest wildlife have received little attention from researchers. An increase in public concern over the impacts of clearcutting, forest-type conversions, and short-rotation forestry on wildlife, as well as recent state and national legislation on threatened and endangered species, has focused attention on cover requirements for wildlife. While considerable progress has been made by state and federal wildlife specialists in determining cover requirements for some game species and cavity-nesting birds, very little is known about such needs for other species.

WATER--Most species of forest wildlife must consume some form of moisture daily; these needs may be met by snow, water, dew, or succulent foods, depending on the species and circumstances. Because water is more readily available in forest ecosystems than in grassland and desert ecosystems, water availability is seldom a limiting factor for the more mobile terrestrial wildlife species. Of course, there are those species that are more closely restricted in their distribution because of their dependence on water for feeding, locomotion, or protection.

The precise needs of forest wildlife for open sources of water are poorly understood. However, there are a few exceptions that will be mentioned below.

Deer and elk show a disproportionately greater use of summer ranges within 1/8 mile of available water (Julander 1966, and Mackie 1970), and optimum habitats should have potable water within 1/2 mile of any point (Mackie). Water requirements for female deer and elk prior to and after parturition are greater than at other times of the year.

Another species that has demonstrated some dependency on available water is the wild turkey (Ligon 1946). Since turkeys commonly go to water soon after leaving their roosts, the proximity of roosts to water is of some importance.

Obviously, there is little the forest wildlife habitat manager can do to enhance water availability for those wildlife species dependent upon water short of maintaining and enhancing existing supplies. On the other hand, to achieve maximum results from other forest manipulation projects, their location with respect to available water should be a primary consideration.

**SPECIES SELECTION AS A
BASIS FOR HABITAT MANAGEMENT**

If wildlife is to be a consideration in forest management, the land manager must go through a species selection process. How involved this selection process might be depends upon the goal of the owner or person in control of the land and the ownership of the land.

Basically, the selection process narrows down to 2 alternatives: (1) management to favor a few species with little or no consideration given to species not selected, and (2) management to provide for the welfare of all indigenous and desirable introduced species. If the land manager desires, he or she may integrate these 2 alternatives on the same forested area. Under Alternative 1, the species selected for management are herein referred to as **emphasis species**. Under Alternative 2, it is impractical to directly manage for all species; therefore, management must be based on a number of representative species herein identified as **indicator species**.

Land ownership enters the species selection process only in the case of public lands, for which species selection is dictated by laws and/or regulation. For example, on national forest system lands, Alternative 2 is mandated by regulation a primary goal and Alternative 1 is encouraged, provided it does not conflict with Alternative 2.

APPENDIX C

WILDFIRE INFORMATION

FOREST SLASH BURNING GUIDELINES FOR LARIMER COUNTY

This handout is designed to be used by forest landowners, land managers, and fire department personnel in Larimer County in planning and conducting safe and effective forest slash burning in woodland situations. It cannot guarantee safety from accidents, unforeseen circumstances, changing burning conditions, or negligent actions of the individual(s) burning slash. By following the intent of these guidelines and common sense, the landowner or forest manager can reduce forest slash accumulations, improve the appearance of their forest land, and reduce wildfire risk on their property.

DEFINITIONS

Slash: The accumulation of limbs, tops, and miscellaneous residue left by forest management activities, such as thinning, pruning, and timber harvesting.

Piling and Burning: The treatment of slash by piling the limbs and tops into manageable piles. Piles are burned during safe burning conditions, generally during the winter following cutting.

Broadcast Burning: The treatment of slash by burning the limbs and tops as they lie on the ground after cutting. The slash must be distributed continuously throughout the burn area to be burned effectively. Burning is generally done during very wet periods or with light snow cover in late fall or early spring.

Mop-up: The final check of the burned slash to identify and extinguish still burning coals or materials. Extinguishment is usually accomplished by covering and mixing snow, water, or soil with the burning fuels.

CONSTRUCTION OF PILES

Pile slash immediately after cutting (while still green), and before winter snowfall. Remove all wood products such as firewood prior to piling. Pile branches and tops with the butt ends towards the outside of the pile, and overlapping so as to form a series of dense layers piled upon each other. Use a mixture of sizes and fuels throughout the pile. This prevents snow from filtering into the pile and extinguishing the fire while it is starting. Piles should be approximately 8 feet across in diameter and 6 feet in height, again to prevent drifting snow from entering the pile. Piles should be kept compact, with no long extensions, to reduce snow filtration and improve ignition. Do not place large stumps and section of logs in the piles, as they will burn for extended periods and will frequently need to be mopped-up.

Do not include garbage or debris in the pile.

Locate piles in meadows, rock outcrops, or openings in forest stands. Do not pile slash over stumps where possible, as these areas will need to be mopped-up. Piles may be situated within forest stands, if they are at least 5 feet away from adjacent tree trunks and tree crowns do not hang over the piles.

PLANNING YOUR BURNING EFFORT

Landowners must complete the following steps before burning slash:

1. Obtain and have approved a burning permit from the Larimer County Health Department, 363 Jefferson St., Fort Collins CO 80524, (303) 498-6775.
2. Signed authorization and approval from the legally constituted Fire Protection District for your area of Larimer County, or from the Larimer County Sheriff's Department, Emergency Services Section.

Burning permits consist of 3 parts, and require the completion of information about the proposed burning. Upon completion of the permit and approval of the Health Department, approval from the responsible fire authorities is required. Upon their approval, the white copy of the permit is retained by the landowner, the yellow copy is given to the responsible fire protection agency, and the pink copy is returned to the Health Department.

The landowner must notify the responsible fire protection agency the day burning is planned (see attached list). Notification of the Larimer County Sheriff's Department, at 498-5312 or 498-5300, is also mandatory and should include the dates, times, and an exact legal description of the burn location. Neighbors should be informed prior to burning as well.

Burning must be done during suitable weather conditions. Periods of snow or light rain, with light winds (for smoke dispersal) and sufficient snow cover (6-12 inches) are ideal. Do not burn during periods of high winds, low humidity or drying conditions, temperature inversions, and lack of snow cover or when these conditions are expected to develop after starting. Control of burning slash must be maintained at all times to reduce wildfire hazard and damage to residual trees. If snow cover becomes sparse during the burning period, additional water sources must be provided for wildfire control and mopping-up efforts. Persons conducting the burning should have at a minimum: leather gloves; shovels and mattocks; leather work boots; work clothing; masks or bandannas for covering the mouth and nose; and proper eye protection.

BURNING SLASH PILES

Piles may be ignited by several means. If the needles and fine fuels within the pile have dried out throughout the summer, than ignition can be easily started with a large ball of newspaper placed within the bottom of the pile. If fuels are still partially green, or the pile is wet from rain or melting snow, then a hotter and longer burning source may be necessary. Sawdust,

saturated with diesel fuel and placed within the bottom of the pile, can be used. Flares used for highway emergencies can also be utilized to ignite the piles. Do not use gasoline for this purpose!

One pile should be burned first as a test pile to see how it burns and at what rate prior to igniting other piles. If suitable burning conditions exist, then additional piles may be started. Ignite only those piles that can be watched with the available manpower until the piles have burned down. Depending on weather conditions, pile size, and moisture content of the fuels, piles should burn down in 20-35 minutes. As a general rule, 3-6 piles per person is a manageable rate if piles are closely situated.

After the piles have burned down, repile any unburned slash and large wood chunks (called "chunking-in") into the beds of coals before starting any new groups of piles. Do not start any new piles after 2:00 p.m. Piles started after this time may continue to burn into the evening and may not burn completely if temperatures drop and relative humidity rises. Additionally, burning piles may need to be mopped-up if weather conditions will not extinguish the piles or the fires pose a hazard. If high winds or warming (and drying) conditions are predicted, then burning piles must be mopped-up.

If landowners have questions about possible problems with burning slash, they should contact the Larimer County Sheriff's Department, Emergency Services Section at 498-5312, or the Colorado State Forest Service, Fort Collins District Office at 491-8660. Information about wildfire hazard reduction for forest land is available from the Fort Collins District, CSFS at 491-8660.

Prepared by the Larimer County Sheriff's Department, Emergency Services Section and the Colorado State Forest Service, Fort Collins District, 12/6/91.

SLASH DISPOSAL

Slash is a term used to describe the limbs, tops, and branches left from thinning and timber harvesting activities. Slash can add significant volume of fuel to the forest. These materials can accumulate and can serve as ladder fuels, or can become hot spots, increasing the difficulty of suppressing wildfire. Slash decomposes very slowly in Colorado and proper disposal is essential.

Three treatment methods commonly used are: (1) lopping and scattering; (2) piling and burning; (3) Chipping. Proper treatment reduces fire hazard, improves access for humans, wildlife, and livestock, encourages establishment of grasses and other vegetation (including seedling trees in some cases), and improves aesthetics. Size, amount, and location of slash dictates the method of disposal used.

Lopping and Scattering is the easiest and cheapest method of disposal, but must be done properly to be effective. Large branches are cut into small sections and scattered over the area. All pieces are cut small enough so all slash is within 12 inches of the ground. (Contact with the ground increases decomposition rates). This method leaves a "messy" appearance to the site for several years, especially if slash is not cut into small enough pieces. Advantages to this method are greater nutrient recovery to the site as slash decomposes, reduced surface erosion, and improved seedling establishment by some species (especially lodgepole pine).

Piling and Burning is a quick way to eliminate a large amount of slash at a moderate cost. Burning is done when sufficient snow cover exists to prevent fire spread. Piles are located far enough away from remaining trees to prevent scorching, and should be compact enough to burn easily. The county sheriff and local fire departments must be notified before any burning is done. In some counties, the Public Health Department requires a burning permit be completed before the burning season. A few scattered piles may be left for wildlife use without compromising wildfire danger.

Pile dimensions will depend upon site specific conditions and manpower, but should be at least 6 feet across by 5 feet high in size (when compacted) to facilitate burning during winter conditions. Piles should be burned during the first winter following cutting for best results. This method requires reentry to the stand, frequently during inaccessible periods, to complete treatment. Cost is slightly higher than lopping and scattering. Adverse weather conditions may delay burning for several years, reducing the effectiveness of this treatment. Advantages to this method are a "clean" site after treatment, improved accessibility within the area, and suitable seedbed for seedling establishment.

Chipping is the most expensive disposal method. Branches are fed through a machine equipped with metal blades that chop the slash into chips approximately 3/4 inch square by 1/3 inch thick. Chips decompose more rapidly than lopped and scattered slash, present little fire hazard, and act as a

mulch to hold soil moisture and prevent erosion on the site. Wood chips may prevent seedling establishment when spread too thick. Chipping is very expensive (1991 costs for CSFS were \$40.00/hour), and requires the slash to be reachable by the equipment used. Chipping must be done within the first year of cutting to be done effectively, as the slash is more difficult to treat as it dries out.

APPENDIX D

INSECT AND DISEASE INFORMATION

service in ACTION

Colorado
State
University
Cooperative
Extension

no. 5.528

Mountain Pine Beetle

and related bark beetles

David A. Leatherman and Whitney S. Cranshaw¹

Quick Facts

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

Trees that are not growing vigorously due to old age, crowding, poor growing conditions, drought, fire or mechanical damage, root disease and other causes are most likely to be attacked.

For a long-term remedy, thin susceptible stands with emphasis on leaving well-spaced healthy trees.

For short-term controls, spray, burn, and peel attacked trees to kill the beetles. Preventive insecticide sprays can protect green, unattacked trees.

Mountain pine beetle (MPB), *Dendroctonus ponderosae*, is an insect native to the forests of western North America. Previously called the Black Hills beetle or Rocky Mountain pine beetle, periodic outbreaks of the insect can result in losses of millions of trees. Outbreaks develop irrespective of property lines, being equally evident in wilderness areas, mountain subdivisions, and back yards. Even windbreak or landscape pines many miles from the mountains can succumb to beetles imported in infested firewood.

Mountain pine beetles develop in pines, particularly ponderosa, lodgepole, Scots (Scotch), and limber pine. Bristlecone and pinyon pine are less commonly attacked. During early stages of an outbreak, attacks are limited largely to trees under stress from injury, poor site conditions, fire damage, overcrowding, root disease, or old age. However, as

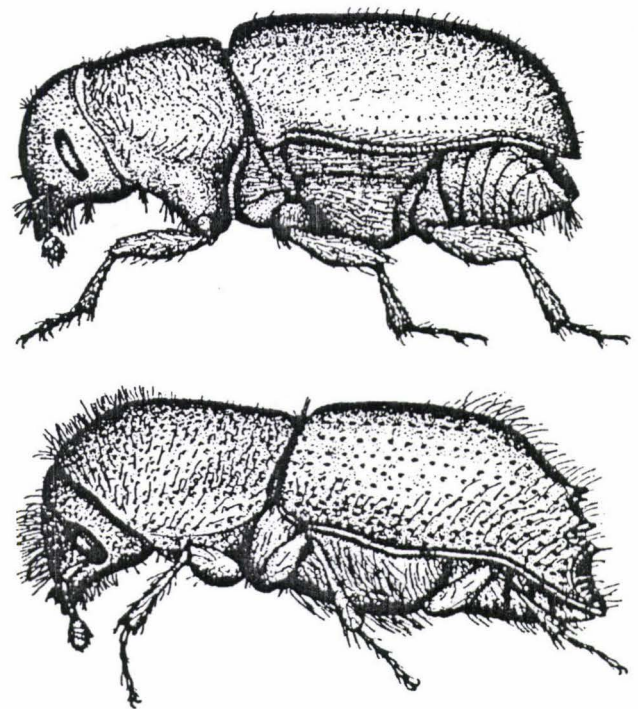


Figure 1: Adult *Dendroctonus* (top) versus *Ips* (bottom). Note gradually curved wing of *Dendroctonus*. Actual size of *Dendroctonus* from 3 to 8 mm; *Ips* 3 to 6.5mm.

beetle populations increase, MPB attacks may involve most trees in the outbreak area.

A related insect, the Douglas-fir beetle (*Dendroctonus pseudotsugae*), occasionally damages

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Douglas-fir. Most often, outbreaks are associated with previous injury by western spruce budworm (Service in Action sheet 5.543, *Western Spruce Budworm*). Spruce beetle, (*Dendroctonus rufipennis*) is a pest of Engelmann and blue spruce in Colorado. Injured pines also can be attacked by the red turpentine beetle, (*Dendroctonus valens*).

Mountain pine beetle, and other bark beetles in the genus *Dendroctonus*, can be separated from other bark beetles by the shape of the hind wing cover (Figure 1). In side view it is gradually curved. The wing cover of Ips or engraver beetles, another common group of bark beetles attacking conifers (Service in Action sheet 5.558, *Ips beetles — characteristics and controls*) is sharply spined; whereas Scolytus beetles, such as the shothole borers and European elm bark beetle, have the area under the wing cover (abdomen) indented.

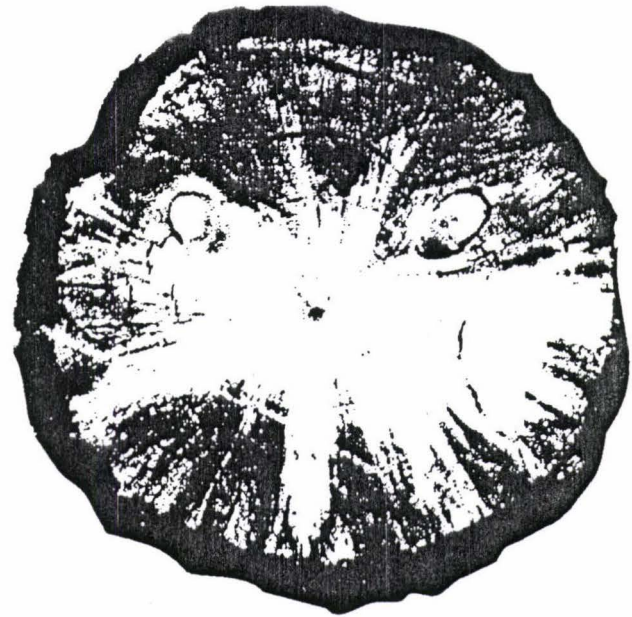


Figure 2: Cross section of ponderosa pine log shows characteristic stain caused by fungus carried on beetle bodies.

Signs and Symptoms of MPB Attack

- Popcorn-shaped masses of resin, called 'pitch-tubes' on the trunk where beetle tunnelling begins. Pitch tubes may be brown or white in color.
- Boring dust in bark crevices and on the ground immediately adjacent to the tree base.
- Evidence of woodpecker feeding on trunk. Patches of bark are removed and bark flakes lie on ground or snow below tree.
- Foliage turning yellowish to reddish throughout the entire tree crown. Usually occurs eight to 10 months after a successful MPB attack.
- Presence of live MPB (eggs, larvae, pupae, and/or adults) as well as galleries under bark. This is the most certain indicator of infestation. A hatchet for removing bark is needed to check trees correctly.
- Bluestained sapwood (Figure 2). Check at more than one point around the tree's circumference.

Life History and Habits

Mountain pine beetle has a one-year life cycle in Colorado. In late summer adults leave the dead, yellow to red needled trees in which they developed. Females seek out living, green trees that they attack by tunneling under the bark. Coordinated mass attacks by many beetles are common. If successful, each beetle pair mates, forms a vertical tunnel (egg gallery) under the bark, and produces about 75 eggs. Following egg hatch, larvae (grubs) tunnel away from the egg gallery producing a characteristic feeding pattern (Figure 3).

MPB larvae spend the winter under the bark. They continue to feed in the spring and transform

into pupae in June and July. Emergence of new adults can begin in early July and continue through September. However, the great majority of beetles exit trees during late July (lodgepole pine) and mid-August (ponderosa pine).

A key part of this cycle is the ability of MPB (and other bark beetles) to transmit bluestain fungi (*Ceratocystis species*). Spores of these fungi contaminate the bodies of adult beetles and are introduced into the tree during attack. Fungi grow within the tree and, together with beetle feeding, weaken the tree. This mutual network of beetle galleries and bluestain fungi disrupt transport of water in the tree and rapidly kill it. The fungus gives a blue-gray appearance to the sapwood.

Control

Natural controls of mountain pine beetle include woodpeckers and insects such as clerid beetles that feed on mountain pine beetle adults and larvae under bark. Extreme cold temperatures also can reduce MPB populations. However, during outbreaks these natural controls often fail to prevent additional attacks.

Perhaps the most important natural control is tree vigor. Healthy trees are less attractive to beetles than trees under stress. Vigorously growing trees also have better defenses that allow them to 'pitch out' pine beetles.

Cultural controls that promote tree health and spacing are the primary means to prevent MPB outbreaks. The best long-term means to minimize

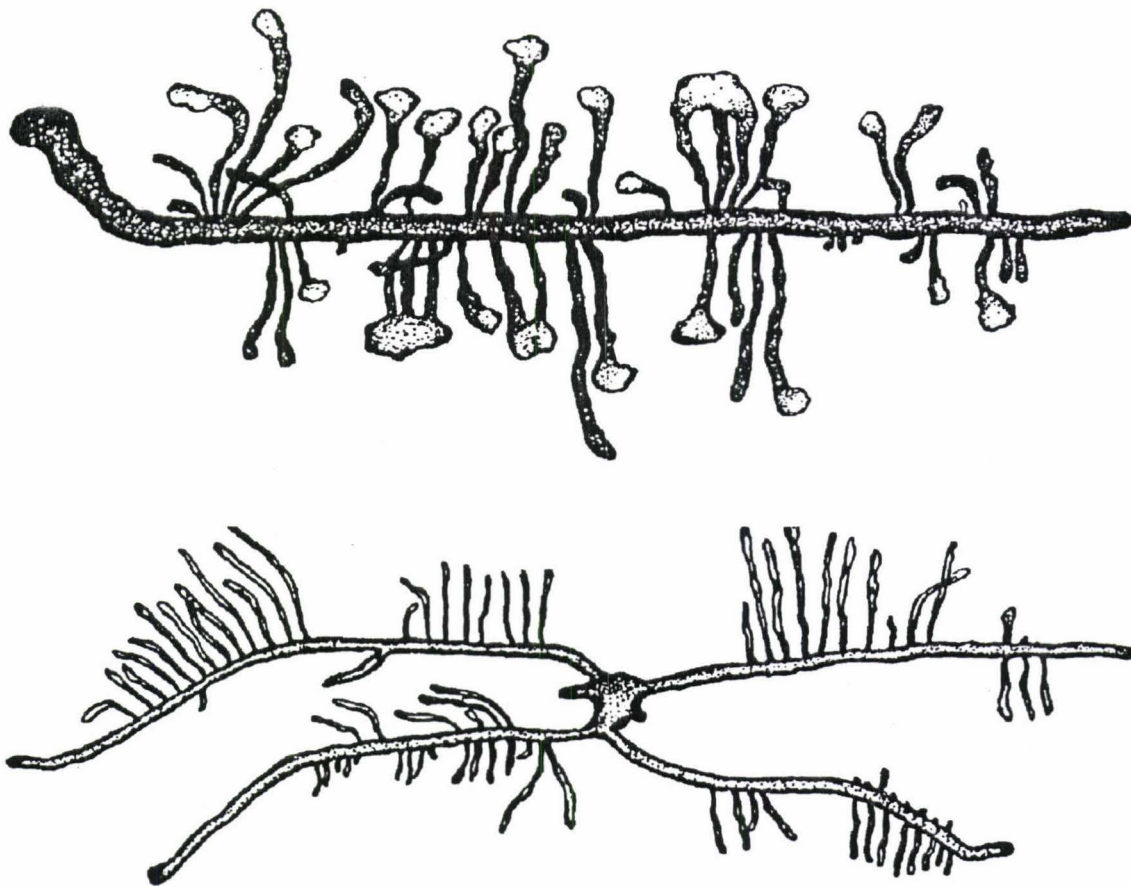


Figure 3: Typical egg and larval galleries produced by *Dendroctonus* (top) versus *Ips* (bottom).

MPB losses is to thin trees. Consult a professional forester to select the best cultural practices for your land.

Logs infested with MPB can be treated in various ways to kill developing beetles before they emerge as adults in summer. Logs may be burned to kill the larvae under bark. Intense solar radiation that dries out the cambium and raises temperatures to lethal levels (110F+) can kill MPB larvae. Beetles also die if the bark is removed by peeling or milling. Burying is another option to kill MPB in infested logs. In some cases, hauling infested logs to "safe sites" a mile or more from susceptible tree hosts also is practiced. Following beetle emergence, wood can be used without threat to other trees.

Chemical control options for MPB have been greatly limited in recent years. Former treatments that involve ethylene dibromide fumigation have been banned. Cacodylic acid (Silvisar products) and most formulations of lindane are unavailable or Restricted-Use. These treatments were primarily used to kill larvae in trees or adults as they emerge. A few formulations of lindane, usually marketed as some brand of 'borer spray', remain available to treat infested logs.)

Certain formulations of carbaryl (Sevin, Sevimol, etc.) are registered for use to prevent attacks on individual trees. These sprays are applied to living green trees in early summer to kill attacking beetles. This preventive spray is quite effective through one MPB flight (one year) in ponderosa pine areas. In lodgepole pine areas, recent evidence indicates one spraying may provide satisfactory protection through two flights (two years).

Always carefully read and follow all label precautions before applying carbaryl for MPB prevention.

Research is ongoing with lures involving special attractants (pheromones) for beetle management. Primarily this has involved pheromones with attract beetles to 'trap' logs or trees where they can be more easily removed or treated. This approach has been effective in Colorado settings where there are trees available for sacrifice. Done correctly, combined with tree treatments, pheromones can be useful in reducing outbreaks in a small area.

Repellent pheromones to disperse beetles from high-value trees also are being developed. However, these have not yet provided consistently reliable protection in Colorado testing.

WESTERN SPRUCE BUDWORM

Western spruce budworm is a defoliating insect pest of Douglas-fir, Engelmann spruce, and blue spruce.

Description

Western spruce budworm (*Choristoneura occidentalis*) is a moth about 12 mm. long. It has gray or orange-brown wings. The forewings are banded, and have a conspicuous white dot on the margin. The larvae, however, is what does the damage. The "caterpillar" is 20 to 23 mm. long and brownish-yellow with a dark brown head.

Life Cycle

The budworm has a one-year life cycle. The eggs are laid in late July or early August. After about 10 days the eggs hatch and the larvae crawl under the bark scales to overwinter. In the spring, the larvae break dormancy and begin feeding on the new needles and expanding buds. The larvae pupate and mature into adults in early July. Eggs are then laid on needles and cycle begins again.

Hosts

In Colorado, Western spruce budworm attacks Douglas-fir, white fir, Engelmann spruce and blue spruce. Normally the young needles and buds are eaten, but during a severe outbreak the old needles may be eaten too. In such situations, if the tree is completely defoliated for several years in a row, it will very likely die.

Symptoms of Attack

The larvae form small "tents" or nests of silk near the tops of trees or at the end of branches. These are for pupation. These nests are readily distinguishable. Severe defoliation is also a good indication of the presence of Western spruce budworm. Of course, if the adults or larvae can be identified, their presence will be confirmed.

Control

Natural controls such as severe weather and predation take their toll, but in a severe outbreak, chemical spraying is the best method. Aerial spraying is common in the Pacific Northwest, but the most practical method of control for landowners having a small amount of trees, is ground spraying. Spraying should be done in early June, when the larvae are exposed, with malathion or Sevin-4-oil.

Prevention of severe outbreaks can be done by managing the forest for mixed stands. In such stands, the budworm isn't able to spread the way it can in an over-crowded, even-aged stand. A forester should be consulted for aid in spruce budworm control.

DWARF MISTLETOE

Dwarf mistletoe is a parasitic plant that severely weakens and sometimes kills its host trees, ponderosa pine and lodgepole pine. normally different species of mistletoe affect ponderosa pine and lodgepole pine. The parasite (Arceuthobium americanum), usually infecting ponderosa pine but occasionally attacking lodgepole pine, greatly reduces the growth of an infested tree. It also limits cone production and thus, reproduction. Dwarf mistletoe infestation also increases susceptibility to other forest pests, especially the Mountain pine beetle.

Life Cycle

Dwarf mistletoe has a six-year life cycle. It flowers in the spring. Seed mature in August and September, a year later. Upon maturing, the seeds are released explosively. Water pressure can expel them at velocities up to 50 feet per second and distances up to 66 feet. The average distance is closer to 20 feet. The seeds are covered with a sticky material and adhere to whatever they touch. If one lands on a pine needle, it will be washed to the base of the needles by rain, where it will sprout and send a shoot into a branch. Three to six years later, shoots appear on the branch of the tree. These shoots usually produce flowers two years after emergence.

Symptoms of Mistletoe Infection

The most conspicuous symptom of mistletoe infection is the presence of mistletoe shoots on the branches or trunk. Swellings on the branch can be caused by mistletoe shoots that are about to emerge. "Witches brooms," or bunches of contorted branches are often caused by dwarf mistletoe.

Control

Severely infested trees should be cut down and disposed of. Such trees will probably die anyway, and are hazardous because of the possibility of dead branches or tops falling down. By leaving them standing, they will only continue to infest other trees. Patch cuts are recommended in an entire stand that is infested.

Trees not severely infested can be pruned, and will regain some of their health and continue to live. If the shoots occur mostly in the lower parts of the tree, the branches that are infested can be pruned off. All pruned branches should be cut off up to and including the highest infected branch. If sufficient live branches remain ($\frac{1}{4}$ to $\frac{1}{3}$ tree height), prune the tree to two feet above the highest infected branches and brush off shoots arising from the trunk. If replanting is done, a mixed forest should be the goal. Where the pines are intermixed with Douglas-fir, for example, the rate of mistletoe spread will be greatly reduced.

RUSTS

Rusts are fungi that invade pines and cause gall and canker formation. Western gall rust (*Peridermium larknesii*) and commandra blister rust (*Cronartium commandrae*) are two common diseases of western pines. The gall rusts cause the tree cambium to divide rapidly, much like a cancer, and form galls. These galls kill the parts of the tree which bear them. Both types of rusts may eventually kill the host tree. Cankers on the main trunk of the tree mechanically kill weaken the tree at that point. Heavy winds will break off the tree at the canker.

Rusts have complex life histories, going through several stages of development. Commandra rust requires a second host, the commandra plant, to complete its life cycle. In both cases, microscopic spores produced by the different lifestages are spread by wind, rain, and animals to the susceptible tissues of the host pines and alternative host plants.

WESTERN GALL RUST

Hosts: Ponderosa pine and lodgepole pine.

Symptoms: Galls (globose - shaped swellings) produced on branches and twigs cause death of individual branches. Galls on main stems enlarge causing "hip" cankers. Yellow-orange blisters develop on galls during the summer.

Importance: Trunk cankers affect the form, lumber content, and growth rate of their hosts and may kill individual trees, but is not known to wipe out entire stands. The rust infects pines of all ages.

Control Strategy: Removal of infected trees during thinning operations and during intermediate cuts is the only practical way to reduce damage.

COMMANDRA BLISTER RUST

Hosts: Lodgepole pine and ponderosa pine (Commandra or bastard toadflax [*Commandra umbellata*], are the alternative hosts).

Symptoms: Spindle-shaped cankers on branches and main stem; flagging (fading) of infected branches; top-kill and death of infected trees.

Importance: Commandra rust affects much of the lodgepole pine stands in the Rocky Mountain Region. It causes spiketops and whole-tree mortality, as well as reducing tree growth and lumber content.

Control Strategy: Control is generally aimed at reducing the disease incidence rather than preventing infections. Salvage harvests of heavily infected stands should be done while the trees are still usable. Trees with commandra rust and dwarf mistletoe should be removed first. Trees with multiple stem cankers, spike tops, and girdling stem cankers in the lower crown of the tree should be discriminated against during any timber stand improvement work.

APPENDIX E

CRUISE DATA

STAND: STAND 1

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	4	0	92	0	0	0	0	0	0	0	0	0	92
CUVOL	4	0	144	0	0	0	0	0	0	0	0	0	144
SCRIB	4	0	592	0	0	0	0	0	0	0	0	0	592
STEMS	6	0	102	61	0	0	0	0	0	0	0	0	163
CUVOL	6	0	189	182	0	0	0	0	0	0	0	0	371
SCRIB	6	0	391	691	0	0	0	0	0	0	0	0	1082
STEMS	8	0	46	92	0	0	0	0	0	0	0	0	138
CUVOL	8	0	168	513	0	0	0	0	0	0	0	0	681
SCRIB	8	0	319	1671	0	0	0	0	0	0	0	0	1990
STEMS	10	0	0	59	7	0	0	0	0	0	0	0	66
CUVOL	10	0	0	511	95	0	0	0	0	0	0	0	605
SCRIB	10	0	0	1613	397	0	0	0	0	0	0	0	2010
STEMS	12	0	0	15	5	0	0	0	0	0	0	0	20
CUVOL	12	0	0	183	77	0	0	0	0	0	0	0	260
SCRIB	12	0	0	636	296	0	0	0	0	0	0	0	933
STEMS	14	0	0	11	4	0	0	0	0	0	0	0	15
CUVOL	14	0	0	185	78	0	0	0	0	0	0	0	263
SCRIB	14	0	0	736	330	0	0	0	0	0	0	0	1065
STEMS	18	0	0	0	5	0	0	0	0	0	0	0	5
CUVOL	18	0	0	0	156	0	0	0	0	0	0	0	156
SCRIB	18	0	0	0	732	0	0	0	0	0	0	0	732
TOTAL													
STEMS	0	0	239	238	21	0	0	0	0	0	0	0	498
CUVOL	0	0	501	1574	405	0	0	0	0	0	0	0	2481
SCRIB	0	0	1303	5347	1754	0	0	0	0	0	0	0	8404

STAND: STAND 1

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
498	164	7.8	39	117

COURSE SUMMARY

BAF USED = 20 PTS SMPLD = 5 AVG. # TREES/PT. = 8.2

STAND: STAND 2

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	10	12	24	0	0	0	0	0	0	0	0	0	37
CUVOL	10	47	147	0	0	0	0	0	0	0	0	0	195
SCRIB	10	98	243	0	0	0	0	0	0	0	0	0	341
STEMS	12	8	0	0	0	0	0	0	0	0	0	0	8
CUVOL	12	49	0	0	0	0	0	0	0	0	0	0	49
SCRIB	12	73	0	0	0	0	0	0	0	0	0	0	73
STEMS	14	0	12	0	0	0	0	0	0	0	0	0	12
CUVOL	14	0	153	0	0	0	0	0	0	0	0	0	153
SCRIB	14	0	537	0	0	0	0	0	0	0	0	0	537

STEMS	0	21	37	0	0	0	0	0	0	0	0	0	58
CUVOL	0	96	300	0	0	0	0	0	0	0	0	0	397
SCRIB	0	170	779	0	0	0	0	0	0	0	0	0	950

STAND: STAND 2

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
58	40	11.3	27	143

CRUISE SUMMARY

BAF USED = 20 PTS SMPLED = 3 AVG. # TREES/PT. = 2.0

STAND: STAND 3

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	4	46	46	46	0	0	0	0	0	0	0	0	138
CUVOL	4	38	77	95	0	0	0	0	0	0	0	0	210
SCRIB	4	142	296	397	0	0	0	0	0	0	0	0	835
STEMS	6	0	61	20	20	0	0	0	0	0	0	0	102
CUVOL	6	0	117	54	81	0	0	0	0	0	0	0	252
SCRIB	6	0	426	372	318	0	0	0	0	0	0	0	1116
STEMS	8	0	0	23	126	0	0	0	0	0	0	0	149
CUVOL	8	0	0	140	977	0	0	0	0	0	0	0	1117
SCRIB	8	0	0	567	3859	0	0	0	0	0	0	0	4427
STEMS	10	0	0	0	73	0	0	0	0	0	0	0	73
CUVOL	10	0	0	0	834	0	0	0	0	0	0	0	834
SCRIB	10	0	0	0	3035	0	0	0	0	0	0	0	3035
STEMS	12	0	0	0	10	0	0	0	0	0	0	0	10
CUVOL	12	0	0	0	154	0	0	0	0	0	0	0	154
SCRIB	12	0	0	0	593	0	0	0	0	0	0	0	593
STEMS	14	0	0	0	7	0	0	0	0	0	0	0	7
CUVOL	14	0	0	0	159	0	0	0	0	0	0	0	159
SCRIB	14	0	0	0	675	0	0	0	0	0	0	0	675
STEMS	16	0	0	0	3	0	0	0	0	0	0	0	3
CUVOL	16	0	0	0	78	0	0	0	0	0	0	0	78
SCRIB	16	0	0	0	351	0	0	0	0	0	0	0	351

TOTAL													
STEMS	0	46	107	89	240	0	0	0	0	0	0	0	482
CUVOL	0	38	194	289	2283	0	0	0	0	0	0	0	2804
SCRIB	0	142	722	1336	8831	0	0	0	0	0	0	0	11032

STAND: STAND 3

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
482	144	7.4	46	130

CRUISE SUMMARY

BAF USED = 20 PTS SMP LD = 5 AVG. # TREES/PT. = 7.2

PROGRAM RMCruz

07:01:28 12-23-1991

STAND: STAND 4

PER ACRE STAND SUMMARY
ALL SPECIES

	DBH	20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	4	57	0	0	0	0	0	0	0	0	0	0	57
CUVOL	4	37	0	0	0	0	0	0	0	0	0	0	37
SCRIB	4	115	0	0	0	0	0	0	0	0	0	0	115
STEMS	6	51	76	0	0	0	0	0	0	0	0	0	127
CUVOL	6	34	112	0	0	0	0	0	0	0	0	0	146
SCRIB	6	229	344	0	0	0	0	0	0	0	0	0	573
STEMS	8	0	43	43	43	0	0	0	0	0	0	0	129
CUVOL	8	0	142	202	263	0	0	0	0	0	0	0	607
SCRIB	8	0	344	344	344	0	0	0	0	0	0	0	1031
STEMS	10	0	0	18	55	0	0	0	0	0	0	0	73
CUVOL	10	0	0	144	554	0	0	0	0	0	0	0	698
SCRIB	10	0	0	147	440	0	0	0	0	0	0	0	587
STEMS	12	0	0	6	13	0	0	0	0	0	0	0	19
CUVOL	12	0	0	75	190	0	0	0	0	0	0	0	264
SCRIB	12	0	0	51	102	0	0	0	0	0	0	0	153
STEMS	14	0	0	0	5	0	0	0	0	0	0	0	5
CUVOL	14	0	0	0	96	0	0	0	0	0	0	0	96
SCRIB	14	0	0	0	421	0	0	0	0	0	0	0	421
TOTAL													
STEMS	0	108	119	68	115	0	0	0	0	0	0	0	411
CUVOL	0	72	254	422	1103	0	0	0	0	0	0	0	1849
SCRIB	0	344	688	541	1307	0	0	0	0	0	0	0	2880

STAND: STAND 4

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
411	135	7.8	40	80

CRUISE SUMMARY

SAF USED = 20 PTS SMPLD = 4

AVG. # TREES/PT. = 6.8

PROGRAM RMCRUZ

07:03:30 12-23-1991

TAND: STAND 5

PER ACRE STAND SUMMARY
ALL SPECIES

	DBH	HEIGHT CLASS											TOTAL
		20	30	40	50	60	70	80	90	100	110	120	
STEMS	6	0	25	0	0	0	0	0	0	0	0	0	25
CUVOL	6	0	48	0	0	0	0	0	0	0	0	0	48
SCRIB	6	0	412	0	0	0	0	0	0	0	0	0	412
STEMS	8	0	14	29	0	0	0	0	0	0	0	0	43
CUVOL	8	0	53	146	0	0	0	0	0	0	0	0	199
SCRIB	8	0	115	229	0	0	0	0	0	0	0	0	344
STEMS	10	9	0	28	0	0	0	0	0	0	0	0	37
CUVOL	10	36	0	225	0	0	0	0	0	0	0	0	261
SCRIB	10	73	0	589	0	0	0	0	0	0	0	0	662
STEMS	12	0	0	32	19	0	0	0	0	0	0	0	51
CUVOL	12	0	0	382	288	0	0	0	0	0	0	0	670
SCRIB	12	0	0	1325	1111	0	0	0	0	0	0	0	2437
STEMS	14	0	0	5	9	0	0	0	0	0	0	0	14
CUVOL	14	0	0	77	194	0	0	0	0	0	0	0	271
SCRIB	14	0	0	307	824	0	0	0	0	0	0	0	1130
STEMS	16	0	0	4	0	0	0	0	0	0	0	0	4
CUVOL	16	0	0	78	0	0	0	0	0	0	0	0	78
SCRIB	16	0	0	333	0	0	0	0	0	0	0	0	333
STEMS	18	0	0	0	3	0	0	0	0	0	0	0	3
CUVOL	18	0	0	0	98	0	0	0	0	0	0	0	98
SCRIB	18	0	0	0	457	0	0	0	0	0	0	0	457
TOTAL													
STEMS	0	9	40	96	31	0	0	0	0	0	0	0	176
CUVOL	0	36	101	907	580	0	0	0	0	0	0	0	1624
SCRIB	0	73	526	2784	2392	0	0	0	0	0	0	0	5776

TAND: STAND 5

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
176	105	10.4	41	100

CRUISE SUMMARY

BAF USED = 20 PTS SMPLD = 4

AVG. # TREES/PT. = 5.3

PROGRAM RMCRUZ

07:05:42 12-23-1991

STAND: STAND 6

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	6	0	34	68	0	0	0	0	0	0	0	0	102
CUVOL	6	0	64	181	0	0	0	0	0	0	0	0	245
SCRIB	6	0	207	469	0	0	0	0	0	0	0	0	676
STEMS	8	0	29	48	10	0	0	0	0	0	0	0	86
CUVOL	8	0	106	243	62	0	0	0	0	0	0	0	410
SCRIB	8	0	229	382	117	0	0	0	0	0	0	0	728
STEMS	10	0	12	55	18	0	0	0	0	0	0	0	86
CUVOL	10	0	82	462	205	0	0	0	0	0	0	0	749
SCRIB	10	0	244	1304	733	0	0	0	0	0	0	0	2282
STEMS	12	0	4	13	8	0	0	0	0	0	0	0	25
CUVOL	12	0	38	166	145	0	0	0	0	0	0	0	348
SCRIB	12	0	107	622	589	0	0	0	0	0	0	0	1317
STEMS	14	0	0	3	12	0	0	0	0	0	0	0	16
CUVOL	14	0	0	51	258	0	0	0	0	0	0	0	310
SCRIB	14	0	0	204	1098	0	0	0	0	0	0	0	1303

TOTAL													
STEMS	0	0	79	187	49	0	0	0	0	0	0	0	314
CUVOL	0	0	289	1103	671	0	0	0	0	0	0	0	2063
SCRIB	0	0	787	2982	2537	0	0	0	0	0	0	0	6306

STAND: STAND 6

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
314	133	8.8	41	140

CRUISE SUMMARY

PLANT USED = 20 PTS SMPLD = 6 AVG. # TREES/PT. = 6.7

STAND: STAND 7

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	4	38	0	0	0	0	0	0	0	0	0	0	38
CUVOL	4	64	0	0	0	0	0	0	0	0	0	0	64
SCRIB	4	247	0	0	0	0	0	0	0	0	0	0	247
STEMS	6	51	0	17	0	0	0	0	0	0	0	0	68
CUVOL	6	56	0	45	0	0	0	0	0	0	0	0	102
SCRIB	6	427	0	247	0	0	0	0	0	0	0	0	674
STEMS	8	0	19	19	0	0	0	0	0	0	0	0	38
CUVOL	8	0	70	97	0	0	0	0	0	0	0	0	167
SCRIB	8	0	133	153	0	0	0	0	0	0	0	0	286
STEMS	10	0	0	43	18	0	0	0	0	0	0	0	61
CUVOL	10	0	0	354	190	0	0	0	0	0	0	0	543
SCRIB	10	0	0	1006	603	0	0	0	0	0	0	0	1609
STEMS	12	0	8	8	21	0	0	0	0	0	0	0	38
CUVOL	12	0	77	102	321	0	0	0	0	0	0	0	499
SCRIB	12	0	243	353	1235	0	0	0	0	0	0	0	1832
STEMS	14	0	0	0	9	0	0	0	0	0	0	0	9
CUVOL	14	0	0	0	194	0	0	0	0	0	0	0	194
SCRIB	14	0	0	0	824	0	0	0	0	0	0	0	824
STEMS	16	0	0	0	10	0	0	0	0	0	0	0	10
CUVOL	16	0	0	0	260	0	0	0	0	0	0	0	260
SCRIB	16	0	0	0	1170	0	0	0	0	0	0	0	1170

TOTAL													
STEMS	0	89	28	87	58	0	0	0	0	0	0	0	263
CUVOL	0	121	147	598	964	0	0	0	0	0	0	0	1829
SCRIB	0	674	376	1759	3832	0	0	0	0	0	0	0	6642

STAND: STAND 7

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
263	117	9.0	41	120

CRUISE SUMMARY

BAF USED = 20 PTS SMPLD = 6 AVG. # TREES/PT. = 5.8

STAND: STAND 8

PER ACRE STAND SUMMARY
ALL SPECIES

		HEIGHT CLASS											TOTAL
DBH		20	30	40	50	60	70	80	90	100	110	120	
STEMS	4	65	0	0	0	0	0	0	0	0	0	0	65
CUVOL	4	73	0	0	0	0	0	0	0	0	0	0	73
SCRIB	4	178	0	0	0	0	0	0	0	0	0	0	178
STEMS	6	15	15	29	15	0	0	0	0	0	0	0	73
CUVOL	6	16	27	78	58	0	0	0	0	0	0	0	179
SCRIB	6	112	65	164	227	0	0	0	0	0	0	0	569
STEMS	8	0	33	33	16	0	0	0	0	0	0	0	82
CUVOL	8	0	121	166	117	0	0	0	0	0	0	0	405
SCRIB	8	0	262	262	366	0	0	0	0	0	0	0	890
STEMS	10	0	5	31	42	0	0	0	0	0	0	0	79
CUVOL	10	0	32	258	447	0	0	0	0	0	0	0	736
SCRIB	10	0	52	673	1490	0	0	0	0	0	0	0	2215
STEMS	12	0	0	0	33	0	0	0	0	0	0	0	33
CUVOL	12	0	0	0	509	0	0	0	0	0	0	0	509
SCRIB	12	0	0	0	1986	0	0	0	0	0	0	0	1986
STEMS	14	0	0	0	5	0	0	0	0	0	0	0	5
CUVOL	14	0	0	0	111	0	0	0	0	0	0	0	111
SCRIB	14	0	0	0	471	0	0	0	0	0	0	0	471
STEMS	18	0	0	0	2	0	0	0	0	0	0	0	2
CUVOL	18	0	0	0	56	0	0	0	0	0	0	0	56
SCRIB	18	0	0	0	261	0	0	0	0	0	0	0	261

TOTAL													
STEMS	0	80	53	93	113	0	0	0	0	0	0	0	338
CUVOL	0	89	180	501	1298	0	0	0	0	0	0	0	2069
SCRIB	0	290	379	1099	4802	0	0	0	0	0	0	0	6570

STAND: STAND 8

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
338	126	8.3	43	110

CRUISE SUMMARY

BAF USED = 20 PTS SMPLD = 7 AVG. # TREES/PT. = 6.3

PROGRAM RMCRUZ

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STAND: STAND 9

PER ACRE STAND SUMMARY
ALL SPECIES

	DBH	20	30	40	50	60	70	80	90	100	110	120	TOTAL
STEMS	4	57	0	0	0	0	0	0	0	0	0	0	57
CUVOL	4	54	0	0	0	0	0	0	0	0	0	0	54
SCRIB	4	103	0	0	0	0	0	0	0	0	0	0	103
STEMS	6	13	51	25	0	0	0	0	0	0	0	0	89
CUVOL	6	14	96	68	0	0	0	0	0	0	0	0	178
SCRIB	6	98	270	208	0	0	0	0	0	0	0	0	576
STEMS	8	0	79	57	14	0	0	0	0	0	0	0	150
CUVOL	8	0	292	291	93	0	0	0	0	0	0	0	675
SCRIB	8	0	630	458	175	0	0	0	0	0	0	0	1264
STEMS	10	0	23	18	18	0	0	0	0	0	0	0	60
CUVOL	10	0	138	150	190	0	0	0	0	0	0	0	478
SCRIB	10	0	228	393	603	0	0	0	0	0	0	0	1224
STEMS	12	0	3	3	6	0	0	0	0	0	0	0	13
CUVOL	12	0	28	38	96	0	0	0	0	0	0	0	163
SCRIB	12	0	80	133	370	0	0	0	0	0	0	0	583
STEMS	14	0	0	0	5	0	0	0	0	0	0	0	5
CUVOL	14	0	0	0	97	0	0	0	0	0	0	0	97
SCRIB	14	0	0	0	412	0	0	0	0	0	0	0	412
STEMS	16	0	0	0	4	0	0	0	0	0	0	0	4
CUVOL	16	0	0	0	100	0	0	0	0	0	0	0	100
SCRIB	16	0	0	0	445	0	0	0	0	0	0	0	445
TOTAL													
STEMS	0	70	156	104	47	0	0	0	0	0	0	0	377
CUVOL	0	68	554	547	576	0	0	0	0	0	0	0	1746
SCRIB	0	201	1208	1192	2006	0	0	0	0	0	0	0	4606

STAND: STAND 9

PER ACRE SUMMARY

STEMS	BA	DBH	HT	AGE
377	128	7.9	37	103

CRUISE SUMMARY

BAF USED = 20 PTS SMPLD = 8

AVG. # TREES/PT. = 6.4

APPENDIX F

SPECIES DESCRIPTIONS

PONDEROSA PINE

(Pinus ponderosa)

Ponderosa pine is the most important pine in Western North America. It makes hard, strong, and fine-grained wood. High-grade ponderosa is used for doors, sashes, frames, and paneling; the low-grade wood for boxes, rafters, pallets, fencing, joists, and railroad ties. It also makes a handsome ornamental tree and hardy windbreak component. Ponderosa pine forests have also produced abundant forage and have long been grazed by domestic livestock. These forest areas produce much of the region's deer, elk, and other wildlife. Seventy species of birds were identified in the ponderosa ecosystem at Estes Park during the 1976 annual Audubon spring bird count. Recreational use has been expanding at a rapid rate.

Ponderosa pine in the Colorado Front Range occurs in the Montane Life Zone. This zone is the first timbered belt above the plains on the east side of the Colorado Rockies. Ponderosa pine is a climax species within its normal altitude zone of 5,500 to 8,800 feet in Larimer County. Annual precipitation is very low for tree growth, averaging from 15 to 20 inches. Approximately two-thirds of the annual precipitation falls during spring and summer when it is most useful for regeneration and growth. Soils are largely granitic in origin.

The first harvest cutting in ponderosa pine forests occurred in the Front Range of Colorado about 1860. During the gold rush years, tens of thousands of acres were virtually clearcut for fuel, mine timbers, and lumber. The tree has been cultivated in the U.S. since 1827 for ornamental purposes.

- Needles - Growing in 2's and 3's up to 7" long. They remain through 3 growing seasons.
- Cones - Up to 4" long. Deciduous. Made up of scales with small prickles. Male and female flowers on same tree.
- Seeds - 1/4" long with 1" wing. Two on each scale. 12,000 seeds per pound.
- Form - symmetrical single bole or trunk. Young trees conical while older trees are flat-topped.
- Age - Reach maturity at 140-180 years.
- Height - Tallest on record is 232 feet (California). Will reach 175 feet in best sites. Usually mature at less than 100 feet in Colorado.
- Diameter - Up to 6 feet at 4 1/2 feet above ground in western forests. May reach 4 feet in Colorado. Normally less than 30 inches.
- Root - Tap root.

Bark - Dark brown to black in young trees (furrowed) yellow-brown to cinnamon-red in old growth (smooth and plate-like).

Stand Characteristics

Dry Site species but gets best development on relatively moist, well-drained soils.

Light Demanding species which does not reproduce naturally under low light intensity.

Root Competition can not be tolerated.

Growth is slow but does respond well to thinning operations (release). Generally grows in pure stands. Douglas-fir can occur as scattered trees in pine stands as well as in pure patches and stands on north-facing slopes and along streams. Also pinyon pine, juniper, and limber pine may be found in pine stands.

Windfall is not a serious problem.

Fire Tolerance is low. Although old, mature, thick barked trees are highly resistant to light ground fires, old trees are killed or severely damaged by severe crown fires. Seedlings and small saplings are killed by light ground fires. Fire is not needed for seedbed preparation, but may be beneficial to reduce a heavy litter layer which would hamper seed germination.

Regeneration - Small quantities of seed are produced annually but large crops are released only at intervals of 3-5 years. Germination is as high as 50 percent in nature. Seedlings can exist under canopy of parent trees but grow quite slowly (only 3-4 feet during first 15-20 years). Reproduction is best in clearings made by fire or logging. There must be abundant seed supply and plenty of moisture for 2 or 3 years in a row to get reproduction. These conditions occur only once in every 20 years and then only in restricted localities.

Destructive Agent - Lightning, high winds, dwarf mistletoe, and mountain pine beetle have been the main causes of mortality. The oldest and least vigorous trees are the most susceptible. Other problem causing agents include ips beetles, pine needle miner, pine tip moth, pine budworm, western red rot, porcupines, deer, and small rodents. High rodent populations were found to be a major obstacle to establishment of natural regeneration.

Management - The principle forest values derived from the Montane zone relate to beauty of the landscape and to various forms of outdoor recreation. Mountain communities located here rely on these values for existence. Tree management normally is not a tool to obtain maximum production of wood products. Instead, it is a means of reducing the damage from mountain pine beetles, dwarf mistletoe, and other agent that can lower the attractiveness and usefulness of the zone. It can be utilized to increase and perpetuate the values of landscape, wildlife, livestock forage production, recreation, and employment.

LODGEPOLE PINE

(Pinus contorta)

Lodgepole pine is one of the most aggressive and hardy of western forest species. It reproduces quickly under many conditions, being more adaptable than many other species. Lodgepole pine is shade intolerant, meaning it cannot grow well or at all where other species are present and growing above it. However, when forested areas are burned or the area otherwise cleared, lodgepole pine will often regenerate and recover the area within a relatively few years provided a seed source is available and the young trees are not shaded out. Lodgepole pine is prevalent at elevations ranging from 8,000 to 11,500 feet. It is commonly associated with ponderosa pine, Douglas-fir, and other western pines. Growth averages 70-100 feet high and 12 to 18 inches in diameter. In the Rocky Mountain region, growth may be somewhat less due to competition and poor conditions.

- Needles - 1 to 3 inches long, in groups of two; green to yellow-green.
- Cones - 3/4 to 2 inches long, occasionally open at maturity but often closed for many years.
- Bark - 1/2 inch thick, orange-brown to gray, covered by thin loose scales.

ASPEN

(Populus tremuloides)

Quaking aspen is the most widely distributed tree of North America. It is fast growing, relatively short-lived, and attains heights of fifty to sixty feet, and diameters of one to two feet. Aspen is a prolific seeder and often grows in pure stands that serve as cover for more tolerant conifers. Aspen is shade intolerant. After thirty or more years, competition from various understory species becomes excessive and much of the aspen dies. The maximum age for aspen is approximately 150 years, the average being somewhat less. It is very susceptible to rot causing fungi.

- Leaves - 1 1/2 to 3 inches in diameter, oval in shape, teeth like edges to leaves.
- Bark - smooth, greenish white to cream colored, bark furrowed lengthwise, often roughed by wart-like lumps.

DOUGLAS-FIR

(Pseudotsuga menziesii)

Douglas-fir is the most important tree in the United States. It produces more lumber than any other species. The Rocky Mountain form is somewhat smaller than the Pacific Coast form, but can still be a very large tree. In Colorado, it may reach heights of 130 feet and diameters of three feet. It grows in pure and mixed stands and, in Colorado, most frequently associates with ponderosa pine and lodgepole pine. Douglas-fir can grow in shaded conditions and so, in many stands, is replacing the pine overstory. It grows from about 6,000 to 10,000 feet elevation in Colorado. Douglas-fir is a shallow-rooted species and so, subject to windthrow unless cuts are carefully planned.

- Needles - 3/4 to 1 inch long; yellow-green or blue-green, light-colored under sides; somewhat flattened, standing out from all sides of the twig. Remain on tree eight or more years.
- Cones - 2 1/2 - 3 1/2 inches long, having a 3-tined bract (protrusion) coming out from under each scale.
- Bark - smooth and white to gray on young trees; reddish-brown to dark brown and heavily ridged or corky on older trees.
- Form - Long, cylindrical bole or trunk, young or vigorous trees have a sharp, pointed, conical shape while older, or less vigorous trees are slightly rounded to irregularly flat-topped.
- Age - Mature at 130-200 years.
- Height - Tallest on record 385 feet (Washington). Rarely over 100 feet in Rocky Mountains.
- Diameter- Maximum in Colorado is 35 inches.
- Roots - Wide spreading lateral.

Stand Characteristics

Best Growth is on deep, rich, well-drained, porous loam soils. Tree is drought resistant and will grow on drier sites.

Intermediate in tolerance to shade. Seedlings will grow in shade or understory but growth is slow under these conditions.

Root Competition can be tolerated on most sites but not on dry sites with ponderosa pine.

Windfall may be a serious problem if stands are opened up on ridges or exposed to very high winds.

Fire Tolerance is low, particularly for small trees and seedlings. Older trees will survive light ground fires, but may be severely damaged or killed by hot crown fires. Fire must be excluded for seedling survival.

Regeneration - Seed can be produced after tree is 20 years or older with heavy seed crops occurring at 5 to 7 year intervals. Germination is good on both mineral and humus soils. Dense thickets spring up rapidly after logging, if fire is excluded.

Growth is slow in a shaded understory, but under favorable conditions of light and moisture, growth can be quite rapid.

Destructive Agents include Western spruce budworm, Douglas-fir bark beetle, Douglas-fir tussock moth, dwarf mistletoe, certain heart rots, and fire.

Management - This is dependent on landowner objectives, but can be for timber production, as a cover or protection tree for watershed values, Christmas tree and bough production, or a component in a well-mixed recreational forest. Forage production can be enhanced by opening stands to admit light to the ground. Best tree growth is produced by regularly spaced thinnings to assure that overcrowding does not occur.

SUBALPINE FIR

(Abies lasiocarpa)

Subalpine fir is a large tree of high altitudes in the Rocky Mountain region. It occurs rarely in pure stands, but more commonly in mixed stands with Engelmann spruce. Other associated species in Colorado are, white fir, Douglas-fir, and limber pine. Subalpine fir can be found at elevations from 8,000 to 11,500 feet. It prefers cool, moist sites.

- Needles - 1 to 1 3/4 inches long, single flat needles; blue-green in color.
- Cones - 2 1/2 to 4 inches long, upright on branches, purple in color.
- Bark - Smooth, grey-white in color, becoming fissured with age.

ENGELMANN SPRUCE

(Picea engelmanni)

Engelmann spruce is a large tree of moist areas and high altitudes in the Rocky Mountain region. It occurs in pure and mixed stands. It is often found in association with subalpine fir at high altitudes. It is found along stream bottoms to lower altitudes, in association with ponderosa pine, lodgepole pine, Douglas-fir, aspen, and blue spruce. Engelmann spruce can be found at elevations from 7,000 to 11,500 feet. It prefers cool, moist sites.

- Needles - 5/8 to 1 1/8 inches long, 4-angled needles; dark or pale blue green; of disagreeable odor when crushed.
- Cones - 1 1/2 to 2 1/2 inches long, light brown in color; with long, thin, flexible scales irregularly toothed and more or less pointed.
- Bark - Grayish or purplish brown, thin, with loosely attached scales.

APPENDIX G

MANAGEMENT ALTERNATIVES

SHELTERWOOD

Shelterwood: The gradual removal of an entire stand in a series of partial cuttings which extends over a period of time.

- A. Age of Trees: Even-aged, i.e., trees are nearly all the same age.
- B. Rotation: Definite period, mature timber is cut at some given age.
- C. Cutting:
 - 1. Cut about one-third of stand, preferably largest trees, to open up entire stand and admit more light, then wait for seed year.
 - 2. After seeding, take out another one-third of stand to make room and light for seedlings; leave the last one-third of stand as an even shelter to protect seedlings against sun, wind, and frost and also to hinder rapid development of weeds and brush.
 - 3. When reproduction is well established and no longer in need of shelter, but is in need of light, last one-third of the mature timber is removed.

Note: In practice the method varies; it may use one or several seed years and may remove the stand in two cuts or in six cuts.

- D. Results: Cuttings usually resemble heavy thinnings. Natural reproduction starts under the protection of the older stand. Within the framework of the shelterwood method, it is possible to achieve wide variation. With long regeneration periods, individual trees of the new stand will have a wide range of age. The stand remains more nearly even-aged than otherwise and is managed as such.

Advantages

- A. Reproduction is generally more certain and complete than with clear-cutting and seed-tree methods.
- B. Best trees are retained until after regeneration is established.
- C. Protects site and aesthetic conditions.
- D. Produces better and more timber than selection cutting.
- E. Length or rotation shortened; one crop is started before the preceding one is harvested.
- F. Growing space more fully utilized than other methods of regenerating even-aged stands.
- G. Operations are more systematic and simpler to administer than those under the selection system.
- H. Less slash disposal problems.
- I. Shading stimulates decomposition and reduces danger of fire. Partial shading is advantageous in lodgepole stands to reduce danger of overstocking.

Disadvantages

- A. Larger number of residual trees and reproduction is apt to be damaged in logging; these also will impede harvesting operations.
- B. Cost of logging is greater than seed-tree or clearcutting.
- C. Intolerant species have greater reproduction loss because of increased shading.
- D. Cutting poor trees first is financially unattractive.

SEED TREE

Seed Tree: The removal of most trees in a stand, leaving a small number of genetically and physically desirable trees as a seed source for regenerating the stand.

- A. Age of Trees: Even aged, i.e., trees are nearly all the same age.
- B. Rotation: Definite period, mature stand is cut at some given age.
- C. Cutting:
 - 1. Select desirable mature trees that are to provide seed source for future stand. Desirable characteristics include diameter and height of tree significantly greater than rest of stand, good form (straight, no forks in stem, etc.) and desirable crown to height ratio (crown $1/3$ -- $1/2$ of total height for conifers). Number of seed trees/acre selected will depend upon species capability to produce seed, height of trees, and site conditions (wind, topography, undergrowth, etc.). Generally, 10-20 trees per acre are more than adequate.
 - 2. Remove all other trees in stand, taking care to not damage seed trees. Removal of slash and noncommercial wood may be necessary to ensure good seed dispersal, and limit regeneration to seedlings originating from seed tree source. Soil scarification through logging and slash dispersal may also be needed for adequate seed germination.
 - 3. When reproduction is established and adequately stocked, seed trees are felled. They may be removed, or left in stand if damage to new stand is undesirable.
- D. Results: Cuttings produce a very open stand condition, with lots of sunlight, wind, and frost conditions. Natural reproduction starts at the same time, resulting in even-aged stand structure.

Advantages

- A. Produces even-aged stands, with more uniformity in size of trees than shelterwood system.
- B. Best trees are used for seed source, producing stands of superior performing trees.
- C. Reduces number of entries to stand, reducing damage to regeneration and site.
- D. Cost of logging is lower than shelterwood systems.
- E. Better regeneration for shade intolerant species than shelterwood.
- F. Larger profits possible by removing more trees earlier in system.

Disadvantages

- A. Damage to reproduction possible when logging seed trees. Avoiding damage to reproduction will impede logging operations.
- B. More slash disposal problems than shelterwood.
- C. Not as effective as shelterwood system for shade tolerant species.
- D. Seed trees subject to windthrow.

CLEARCUT

Clearcut: Removal of all trees within a stand, providing an open area for natural or artificial regeneration of stand.

- A. Age of Trees: Even-aged.
- B. Rotation: Definite period, mature stand is cut at some given age.
- C. Cutting:
 - 1. Size of cutting depends on economics, species characteristics (slope, exposure, wind, etc.), and aesthetic and wildlife considerations. Cuts in size of 1-10 acres are generally called "patch" cuts. Larger sizes are possible, and are called clearcuts,
 - 2. Select area of stand, or entire stand, to be cut. All trees, including non-commercial (unusable) trees, are cut. Commercial wood is removed, uncommercial wood is either removed or left on site. All trees are cut to eliminate competition to regeneration.
 - 3. Tops, limbs, and unusable wood, also called "slash", are treated. Treatment can occur as lopping and scattering slash throughout the stand, or by piling and burning slash. Burning can be done in smaller piles scattered throughout the area, or in larger piles or windrows. Burning is generally done with snow cover present.

Lopping and scattering is done to increase decomposition rates, and to allow cones in the slash to distribute seed throughout the area for natural regeneration. Decomposing slash returns nutrients to the site very gradually, and helps protect the site. Piling and burning remove slash from the site immediately, but does not return as many nutrients to the site.
 - 4. Natural or artificial regeneration are used to replace the harvested stand. Natural regeneration can occur from seed distributed by slash, from adjacent stands. Artificial regeneration is accomplished by seeding or planting seedlings.
- D. Results: Creates openings in forest cover. Size and area of cutting is determined by management objectives. The stand will be even-aged.

Advantages

- A. No competition from other trees to reproduction.
- B. Operations easiest to design and administer.
- C. No damage to residual stand or reproduction.
- D. Cost of logging lowest of any method.
- E. Profit is maximized with this system.
- F. Some species will not regenerate without this type of system, such as aspen.
- G. May produce large amounts of regeneration in some species, i.e., lodgepole pine.

- H. Can be used to develop wildlife habitat, by increasing browse and forage material in cut areas.

Disadvantages

- A. Large amount of slash disposal.
- B. Aesthetically displeasing, i.e., "messy-looking."
- C. Not suitable for shade tolerant species.
- D. Regeneration may be limited by harsher site conditions, or by slash in cut area.
- E. Site disturbance greater at time of harvest than other systems.
- F. Requires cutting of all trees in area, including unusable (noncommercial) trees.
- G. Windthrow damage in adjoining stands possible, where cuts are poorly designed.

SELECTION METHOD (Single-Tree)

Selection Method (Single-Tree): Removal of single mature trees.

- A. Age of Trees: All-age or even-age stands.
- B. Rotation: Age at which mature timber is cut. Determined by size, i.e., diameter limit.
- C. Cutting: Stand is cut every ten to twenty years back to a growing stock level of 80. The cut takes out the large, "ripe" trees including all defective, insect infested or diseased trees.
- D. Results: Trees are all ages and sizes occupy the same acreage and furnish a great variety of sizes at any time.

Advantages

- A. Keeps a forest cover.
- B. Gives a variety of sizes on a small area of land.

Disadvantages

- A. No acres are freed of root competition to provide enough space for reproduction -- this is peculiar to the Front Range of Colorado.
- B. Costs more to log.
- C. Much injury to young reproduction by logging.
- D. Produces less timber.
- E. Is irregular and difficult to control; therefore, apt to be overcut or undercut.
- F. To be really successful, involves very intensive management.

GROUP SELECTION

Group Selection: Removal of a group of mature trees with intent to obtain natural regeneration from seeds produced adjacent to the cut-over area.

- A. Age of Trees: Uneven-aged, i.e., containing a mixture of even-aged groups rather than a mixture of age classes by single trees.
- B. Rotation: Determined by size, i.e., diameter limit.
- C. Cutting: One-half to 1 acre in size; stand is cut every 10 years to a growing stock level of 80. Cut removes large "ripe" timber, including all defective, insect infested or diseased trees.
- D. Reproduction: Clearly defined even-aged aggregations.
- E. Results: A stand is created that is more readily adapted to a wider variety of conditions than any other because the ecological requirements of most species can be met within its framework. Stand of all-aged, even-aged groups. If the total area is occupied by all ages, classes can be determined with a fair degree of accuracy. The cut under the group selection method can be regulated by either the area or by volume.

Advantages

- A. Harvesting is cheaper.
- B. Less damage to reproduction and residual stand.
- C. Reproduction develops in even-aged aggregations, thus reproduction has better form.
- D. Less root competition--more reproduction.
- E. Wildlife profits from combination of environmental conditions existing along boundaries between young and old trees.

Disadvantages

- A. Root competition from older trees along perimeters.
- B. Competition for soil moisture and nutrients.

DESIRABLE BASAL AREA OF RESIDUAL STANDS

Growing Stock Level 100

Average DBH After Cutting (inches)	Average Spacing Between Trees (feet)	Stems Per Acre	Actual Basal Area (Sq. Ft.)
2	8X8	686	15.1
3	9X9	604	29.6
4	9X9	507	44.1
5	10X10	430	58.5
6	11X11	361	70.8
7	12X12	306	81.7
8	13X13	260	90.1
9	14X14	219	96.9
10	15X15	183	100.0
11	16X16	152	100.0
12	18X18	127	100.0
13	20X20	108	100.0
14	22X22	94	100.0
15	24X24	81	100.0
16	25X25	72	100.0
17	26X26	63	100.0
18	28X28	57	100.0

Growing Stock Level 80

Average DBH After Cutting (inches)	Average Spacing Between Trees (feet)	Stems Per Acre	Actual Basal Area (Sq. Ft.)
2	9x9	550	12.1
3	10x10	483	23.7
4	10x10	404	35.2
5	11x11	344	46.8
6	12x12	289	56.6
7	13x13	245	65.4
8	14x14	208	72.5
9	16x16	175	77.5
10	17x17	147	80.0
11	19x19	121	80.0
12	21x21	102	80.0
13	22x22	87	80.0
14	24x24	75	80.0
15	26x26	65	80.0
16	28x28	57	80.0
17	29x29	51	80.0
18	31x31	45	80.0

Table 1: Growing stock levels for ponderosa pine. Average distance between residual trees in the stand in relation to average stand diameter after thinning to the growing stock levels.

DBH	GSL 40	GSL 60	GSL 80	GSL 100	GSL 120
=====					
- - - - - (Distance between trees, in feet) - - - - -					
1.0	11.4	9.3	8.0	7.2	6.6
2.0	12.5	10.2	8.9	7.9	7.2
3.0	13.4	11.0	9.5	8.5	7.8
4.0	14.7	12.0	10.4	9.3	8.5
5.0	15.9	13.0	11.3	10.1	9.2
6.0	17.4	14.2	12.3	11.0	10.0
7.0	18.9	15.4	13.3	11.9	10.9
8.0	20.5	16.7	14.5	13.0	11.8
9.0	22.3	18.2	15.8	14.1	12.9
10.0	24.4	19.9	17.2	15.4	14.1
11.0	26.8	21.9	19.0	17.0	15.5
12.0	29.2	23.9	20.7	18.5	16.9
13.0	31.7	25.9	22.4	20.0	18.3
14.0	34.1	27.9	24.1	21.6	19.7
16.0	39.0	31.8	27.6	24.7	22.5
18.0	43.9	35.8	31.0	27.7	25.3
20.0	48.7	39.8	34.5	30.8	28.1

Table 2: Growing stock levels for lodgepole pine. Average distance between residual trees in the stand in relation to average stand diameter after thinning to the growing stock levels.

DBH	GSL 50	GSL 60	GSL 70	GSL 80	GSL 90	GSL 100	GSL 110	GSL 120
=====								
- - - - -	(Distance between trees, in feet - - - - -)							- - -
2.0	11.1	10.2	9.4	8.8	8.3	7.8	7.5	7.2
3.0	12.0	11.0	10.2	9.5	9.0	8.5	8.1	7.8
4.0	13.2	12.0	11.1	10.4	9.8	9.3	8.9	8.5
5.0	14.4	13.0	12.0	11.3	10.6	10.1	9.6	9.2
6.0	15.6	14.4	13.2	12.3	11.6	11.0	10.5	10.0
7.0	16.9	15.4	14.3	13.3	12.6	11.9	11.4	10.9
8.0	18.3	16.7	15.5	14.5	13.6	13.0	12.3	11.8
9.0	20.1	18.2	16.8	15.8	14.9	14.1	13.4	12.9
10.0	21.8	20.1	18.4	17.2	16.2	15.4	14.7	14.1

APPENDIX H

MARKET INFORMATION

LOCAL MARKETS

COMPANY/INDIVIDUAL	ADDRESS	PHONE	CONTACT
Louisiana Pacific Walden	PO Box 778 Walden CO 80480	723-8231	Eric Sorenson
Louisiana Pacific Saratoga	PO Box 809 Saratoga WY 82331	(307) 326-5241	Dave Slater
Big Horn Lumber Co.	1100 South Pine Laramie WY 82070	(307) 742-3237	Dean Alexander
Forks Lumber Co.	1920 Westview Rd Fort Collins CO 80524	493-0625	Dale Moon
Mountain View Lumber Co.	2532 W County Rd 54G Fort Collins CO 80524	224-3877	Ron Bockman
United Wood Products	7860 Diagonal Hwy Longmont CO 80501	652-2286	Raul Bustamonte
Colorado Wood Products	1313 W County Rd 60E Fort Collins CO 80524	484-3758	V. O. Augustine
Westridge Forest Products	2000 N County Rd 23 Bellvue CO 80512	482-3227	Ron Sondrup
Elkhorn Lumber Co.	RR #1, County Rd 23 Livermore CO 80536	881-2284	Russel Robinson
Needmore Forest Products	PO Box 326 LaPorte CO 80535	484-3696	Mark Horvat
Majestic Log Homes	PO Box 772 Fort Collins CO 80522	224-4857	Brad Burgat
Anson Perina	3900 Bingham Hill LaPorte CO 80535	493-5826 (home)	Anson Perina
George & Howard Hersh	237 N Overland Trail Fort Collins CO 80521	482-8530 (home)	George Hersh

Unless otherwise noted, the area code is (303).

MARKET INFORMATION

COMPANY NAME: Louisiana Pacific, Walden
PRODUCT: Sawlogs
SPECIES USED: LP, ES
PRICE PAID*: \$130-150/MBF
MERCHANTABILITY STANDARDS: Lengths: 16'-6", 33'-0", 49'-6"
Minimum 6' top diameter

COMPANY NAME: Louisiana Pacific, Saratoga
PRODUCT: Sawlogs
SPECIES USED: LP, ES, SF, PP
PRICE PAID*: \$110/MBF
MERCHANTABILITY STANDARDS: Tree length, minimum 5" top diameter

COMPANY NAME: Big Horn Lumber Company
PRODUCT: Sawlogs
SPECIES USED: LP, ES, SF, PP
PRICE PAID*: \$76/MBF
MERCHANTABILITY STANDARDS: Tree length, minimum 6" top diameter

COMPANY NAME: Forks Lumber Company
PRODUCT: Sawlogs
SPECIES USED: LP, ES, DF, PP
PRICE PAID*: \$140/MBF
MERCHANTABILITY STANDARDS: Tree length, 12-15" butt diameter

COMPANY NAME: Mountain View Lumber Company
PRODUCT: Sawlogs, Posts and Poles
SPECIES USED: LP, ES, DF, PP
PRICE PAID*: \$150/MBF
MERCHANTABILITY STANDARDS: Tree length

COMPANY NAME: United Wood Products
PRODUCT: Sawlogs, Post and Poles
SPECIES USED: LP, ES, PP
PRICE PAID*: \$750/load (80,000-85,000 lbs. per load)
MERCHANTABILITY STANDARDS:

COMPANY NAME: Colorado Wood Products
PRODUCT: Sawlogs, Post and Poles
SPECIES USED: LP, ES
PRICE PAID*: varies
MERCHANTABILITY STANDARDS: Tree length

*These prices are variable and subject to change.
Taken from Market Report for Union Pacific, 2/90, 1990.

COMPANY NAME: Westridge Forest Products
PRODUCT: Post and Poles
SPECIES USED: LP
PRICE PAID*: \$.015/linear foot
MERCHANTABILITY STANDARDS: Tree length, minimum 3.5" top diameter.

COMPANY NAME: Elkhorn Lumber Company
PRODUCT: Sawlogs, Houselogs
SPECIES USED: LP, ES, PP, DF, SF
PRICE PAID*: \$120/MBF
MERCHANTABILITY STANDARDS: Lengths: 16'-6"; 33'-0"; 49'-6"
Minimum 6" top diameter.

COMPANY NAME: Needmore Forest Products
PRODUCT: Shakes
SPECIES USED: LP
PRICE PAID*: \$150/MBF
MERCHANTABILITY STANDARDS: Tree length, or 8' minimum length,
Minimum 6" top diameter.

COMPANY NAME: Anson Perina
PRODUCT: Posts and Poles
SPECIES USED: LP
PRICE PAID*: \$0.75 each for 6'-6" log with 3.5"-4.5" top diameter,
\$1.00 each for 8'-0" log with 3.5"-4.5" top diameter,
\$1.10 each for 8'-0" log with 4.5"-7.5" top diameter,
\$1.50 each for 10'-0" log with 4.5"-7.5" top diameter.
MERCHANTABILITY STANDARDS: see above.

COMPANY NAME: George and Howard Hersh
PRODUCT: Christmas Trees, Transplants
SPECIES USED: LP, AS, ES
PRICE PAID*: \$1.00 each for small aspen whips,
\$3.00 each for large aspen transplants (6'+),
\$1.00 each for small lodgepole transplants,
\$3.00 each for 4'-5' lodgepole transplants,
\$3.00 to \$5.00 each for Christmas Trees (LP, ES)
MERCHANTABILITY STANDARDS: see above.

*These prices are variable and subject to change.
Taken from Market Report for Union Pacific, 2/90, CSFS.

