1962

Timber Management Guide

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TIMBER MANAGEMENT GUIDE

Aspen Type
1962

ROCKY MOUNTAIN REGION

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

REGION 2 DENVER, COLORADO

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For
ASPEN
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Introduction

This guide is concerned primarily with the management of aspen stands for the production of wood products.

Recent inventories indicate that there are more than 1-1/2 billion cubic feet of aspen, in trees 5.0" d.b.h. and larger, on some 2 million acres in the Region. Eighty percent of this volume is in poletimber size stands. Most of the commercial aspen stands, 95 percent, are in the State of Colorado. The better stands of commercial size aspen are found west of the Continental Divide.

Aspen forms truly multiple-purpose forests. The type is very important for its soil building and erosion control properties. Aspen sprouts and the herbaceous vegetation associated with the type provide good forage for domestic animals and wildlife. It is an excellent cover type for game. Esthetically, it is the outstanding type in the Region, thus enhancing the recreation potential. As a commercial source of wood, the species is becoming more in demand each day. Matchstock, core stock, veneer, excelsior and lumber are now being produced in Colorado. Under sound management there should be few conflicts between the production of merchantable aspen and other uses of the land.

Characteristics

Aspen is a very intolerant tree. For best growth, aspen requires a deep, fresh or moist, porous, well-drained loam soil. It occurs on a wide range of soils in the Rocky Mountains but growth and development, vigor and maturity are governed to a large extent by site.

Aspen occurs in pure stands and in mixtures. In the Rocky Mountains it mixes most commonly with Engelmann spruce, subalpine fir and lodgepole pine.

Rapid growth and high mortality are characteristic of young aspen forests. The species has a strong ability to express dominance, hence stagnation due to heavy stocking is extremely rare. Aspen responds well to thinning, especially in early life. Very heavy thinning, however, may permit sunscald injury to residual trees.

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Aspen reproduces mainly by root suckers and only rarely by seed in the Rocky Mountains. It retains the ability to produce suckers into old age. The ability to reproduce by suckering and to grow rapidly on a wide range of soils fits it well to take over lands that have been cut over or burned.

Fire is credited with the large area of aspen stands. Small aspen sprouts are found throughout the softwood type in Colorado. This indicates that the species occurred in the original stand. As fires destroyed the coniferous canopy and seed source, the protected aspen roots sprouted the existing extensive stands of aspen. The suckers normally come in abundantly and grow rapidly, whereas regeneration of conifers depends on the presence of seed and the seedlings start slowly.

In most places where aspen is found on good sites it has probably taken over lands that were formerly occupied by conifers. In many places the conifers are returning and form a definite understory beneath aspen stands. With effective fire control, aspen undoubtedly will be replaced gradually on such lands, but the process may be slow.

Aspen is suitable for many uses. Colorado aspens are currently used for veneer, lumber, core stock, and excelsior. The veneer is used in making matches, for cross banding, and for furniture. Only the best sites produce good veneer trees. There are no markets at the present time in the Region for the smaller sizes of trees that are merchantable for pulp and box material in the Lake States and eastern regions.

Site Quality and Rotations

Site quality ratings of Baker (1) will be used in Region 2. Baker's table includes sites I through IV. Site V is also recognized but height-age relations are not published. Site V can be recognized by extrapolation of Baker's table which is reproduced on the following page.

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Criterion of Aspen Site Quality

Age	Height of Dominant Trees				Age	Height of Dominant Trees			
	Site 1	Site 2	Site 3	Site 4		Site 1	Site 2	Site 3	Site 4
	Feet	Feet	Feet	Feet		Feet	Feet	Feet	Feet
10 years	13	11	8	6	90 years	80	71	60	47
20 years	25	19	15	13	100 years	81	74	63	49
30 years	37	29	23	19	110 years	82	75	66	--
40 years	47	38	30	24	120 years	83	76	--	--
50 years	57	48	37	30	130 years	83	--	--	--
60 years	66	55	44	35	140 years	83	--	--	--
70 years	73	62	50	40	150 years	83	--	--	--
80 years	77	67	55	44					

The rotation age will be 80 to 90 years on sites I and II unless markets and stand conditions make it good business to hold some stands longer.

Site III aspen should be cut whenever it can be marketed. To avoid excessive cull, rotation age should not exceed 60 years.

Sites IV and V offer little promise for producing aspen wood products. The stands are likely to deteriorate at an early age. If the aspen is to be maintained for purposes other than wood products, some kind of stand treatment may be required by age 50 or 60 years.

Stand Conditions

Three stand conditions are recognized for management of commercial aspen.

1. Pure, even-aged aspen.
2. Pure, two-aged to all-aged aspen.
3. Mixed aspen and conifers.

Pure, even-aged stands are single-storied stands in which 80 percent or more of the trees that make up the canopy are aspen. Small sprout growth or understory conifers may be present.

Pure, two-aged to all-aged aspen contains 80 percent or more of aspen in the main story. Stands, that were thinned in the past by light ground fire or other agency, may contain a distinct second story. Stands that are breaking up from old age may approach an all-aged condition.

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Mixed aspen and conifers are stands that contain more than 20 but less than 80 percent of aspen in the main canopy.

Damaging Factors

Fire, diseases, insects and animals may be damaging to aspen. The wood-rotting fungi and stem cankers are of the greatest significance.

Aspen is highly susceptible to injury by fire. Fire may kill the trees outright or cause basal scars which serve as avenues for wood-rotting fungi. According to Davidson (2) the fungi found most frequently and causing the greatest amounts of decay in aspen in Colorado are, in order of importance, Fomes igniarius var. populinus, Cryptochaete polygonia, Callybia velutypes, Fomes applanatus, Pholiota squarrosa. The first two enter primarily through dead branch stubs. Callybia enters primarily through bark injuries, usually basal scars. F. applanatus and P. squarrosa enter through roots or basal injuries. F. applanatus is parasitic on roots. It destroys roots and renders trees subject to windthrow in addition to causing butt rot. Wood decays should not be serious factors in managed stands that are cut within the recommended rotation ages.

Cankers are likely to prove more serious than wood decays in young stands. Three cankers are important or potentially important causes of death and cull. These are: the black canker of aspen, the sooty-bark canker, and the Hypoxylon canker.

The cause of the black canker is not known; typical older cankers present a central dead area surrounded by a series of calluses from which the old rigid bark stands out in ragged fragments. It apparently attacks stands of all ages. It is very damaging in some localities. Although the exposed wood frequently does not decay, the eccentric growth destroys the utility of the trees for many purposes.

The sooty-bark canker is caused by the fungus Cenangium singulare. The fungus enters through wounds in the bark and spreads rapidly, frequently girdling and killing the trees within one to three years. Infected bark adheres tightly to the tree and becomes a uniform sooty-black throughout, except for the thin outer layer. The margin

between the dead black bark and adjoining healthy bark is sharp. The canker is seldom found in stands younger than 60 years. The Cenangium canker is potentially very damaging. In one recent cutting on the Uncompahgre National Forest, every tree that was scarred even slightly by logging became infected. Many of the infected trees were dead within two years. It continues to shed spores long after the tree has died. No direct control measures are known.

Hypoxylon canker is very damaging to aspen in the Lake States and it is present in the Rocky Mountains. It is potentially dangerous as no direct control measures are known.

Wetwood disease is common in southwestern Colorado. To date, there is no known control. The disease has been of concern in aspen sales for matchstock.

A defoliating leaf blight caused by Marssonina populi (Lib) Magn. is also damaging in some years and especially on susceptible clones. Affected leaves develop spots of varying size and irregular outline. The spots are at first tan or brownish and later turn blackish in color. Leaf tissue bordering the spots is yellow to golden. Discoloration starts in July or August. One result of the disease is premature defoliation which reduces increment. Repeated defoliation kills twigs and sometimes trees.

Many kinds of insects attack aspen. Their influence in aspen management is not fully understood because the biology and ecology of most species has not been worked out. The borers probably are the most damaging insect pests because their oviposition scars and tunnels provide courts of entrance for disease and decay organisms in addition to the mechanical damage. The most common borers are the poplar borer (Saperda calcarata Say) and several species of Agrilus. The female poplar borer gnaws an oval hole through the bark in which to lay eggs. The larvae hatch and extend their mines through the bark and wood. Fibrous frass is exuded in large quanities from a hole marking the point of oviposition. Three years are required to complete the life cycle. Little is known about the Agrilus flatheaded borer in aspen. The borers make the long sinuous galleries in the cambium and outer sapwood.

Outbreaks of the Great Basin tent caterpillar (Malacosoma fragile Stretch) envelop extensive areas in southern Colorado at 10 to 15-year intervals. When the outbreaks persist for as long as five years, mortality of trees in the older stands can be expected. Also defoliation will make the trees more susceptible to borer damage and in turn hasten stand deterioration. Tent caterpillars can be controlled by aerial application of DDT. More lasting control measures with a polyhedral virus disease are now being explored.

Animals may damage aspen by browsing sprouts or gnawing bark. Sheep are the worst offenders, followed by elk, other browsing animals, and rodents. Baker wrote "...sheep grazing is especially destructive on clearcut areas and that if it is continued for three consecutive years all aspen sprouts will be absolutely killed out." Damage by cattle is normally not serious under proper stocking. The same is probably true for deer and elk. But all browsing animals, if over-abundant, can be very destructive to small sprouts. Mice gnaw the bark for food, especially in years of peak populations. At such times they may destroy many small sprouts. They rarely cause serious damage to large trees. Gophers and rabbits may destroy many sprouts but usually are important only on small areas. Damage from elk feeding on the bark of aspen is usually negligible on the better sites. Damage to reproduction may be severe on overstocked winter range. Usually, the better sites are protected by snow and do not comprise a part of winter game range.

Objectives of Management on Lands Designated for Timber Production

To produce from aspen-bearing lands a maximum combination of values and services, considering all uses.

Manage sites I and II primarily for the production of aspen. The objective of site I will be to grow aspen to a size and quality suitable for veneer. Established mixed stands on sites I and II will be maintained as a mixed type.

Merchantable site III will be harvested as markets permit. Convert to a coniferous type after the harvest cut.

Site III, unmerchantable because of defect, and sites IV and V on lands dedicated to timber production will be converted to conifers as quickly as funds permit.

Silvicultural System

Regeneration (harvest) cut will consist of clearcutting at rotation age with the objective of even-aged management. Reproduction of aspen will be by sprouts. Reproduction of conifers will be by planting or seeding.

Intermediate cut will normally be limited to cleaning or thinning operation on sites I and II and partial cutting of two-storied stands.

Cutting Practices

A. Pure, even-aged aspen. Clear cut at rotation age. Culls of merchantable size should be felled, preferably as part of the sale area betterment program. Where logging and cull removal does not remove the whole stand, provision should be made to reduce the crown canopy of the residual stand to not more than 15 percent. The reduction to 15 percent should take place within three years after cutting. Conifers of merchantable size should be harvested with the aspen. Good quality conifers of submerchantable size should be saved.

B. Pure, two-storied and uneven-aged aspen. The objective will be to convert the stand to even-aged in not more than two cutting cycles.

To be treated as two-storied or uneven-aged, a stand must contain sufficient prospective future crop trees of submerchantable size to permit a second cut. Prospective crop trees must be five inches or more in diameter, of good form and vigor, with at least 1/4 of bole length in live crown, and free of defect that will cause the tree to be cull within 20 years. Fresh logging scars around the base of the trees will not affect crop tree status; long bole injuries will. Trees less than five inches d.b.h. should be considered advanced reproduction, and held to harvest in the second rotation.

The minimum acceptable residual stand that should be held for a second cut should contain not less than 75 to 100 prospective crop trees to the acre.

All other stands will be treated as even-aged.

C. Mixed stands of aspen and conifers. Since aspen is very intolerant, the natural trend of succession is from aspen to the more tolerant conifers. Any cutting will encourage the persistence of aspen.

Established mixed stands on sites I and II will generally be maintained as such. These stands should be cut under the same guides as used for pure aspen. Mature trees of all species should be harvested. Culls of merchantable size should be felled. Special care should be exercised to minimize injury to all submerchantable-sized conifers. In any subsequent stand improvement work, residual aspens that are competing with promising understory conifers should be removed.

Conversion to Other Species

Most aspen stands in the Region will naturally revert to conifers provided there is an adequate coniferous seed source. Natural reconversion may take more than one rotation period. The reconversion may be speeded up by underplanting with spruce, lodgepole pine or ponderosa pine. After the seedlings are well established, one or more release treatments will be required. This may be done by either cutting or poisoning (herbicides) the aspen. Intolerant species such as the pines require overhead light for development; therefore, early release is essential. Timber stand improvement plans prescribing planting under aspen must also provide for the necessary release operations.

Cultural Practices and Protection

A. Commercial aspen stands.

1. Stand treatment following clearcutting. Treatment of residual stands following clearcutting will have the objective of eliminating any merchantable-sized culls that remain, reducing the residual canopy to not more than 15 percent. In reducing the canopy, diseased and defective trees should be removed first. If after harvesting, the residual canopy is already less than 16 percent, no additional treatment will be needed. The work should be done concurrently with logging or as soon after as practicable.

2. Stand treatment following the first cutting in two-storied or uneven-aged stand. The objective of stand treatment will be to remove only non-crop trees that are interfering with the development of potential crop trees. Potential crop trees are defined in section B under Cutting Practices. All other trees should be left to restrict sprouting until the second cut which should be a clear cut. Stand treatment should be concurrent with logging, or as soon after logging as practicable.

3. Mixed stands. Follow the guides for pure aspen. Favor good quality trees of higher valued species.

4. Cleaning or Thinning. Thinning of sprout stands that come in after clearcutting will be limited to sites I and II. Due to the heavy mortality of sprouts during the first few years, thinning operations should be delayed until there is an indication of dominance. This will normally take place 10 to 15 years after clearcutting. The thinning should aim to leave about 600-900 trees to the acre (spacing seven to eight feet between trees).

Cleaning or thinning operations should be used to shape the future stand. Diseased, defective, and poorly shaped trees should be removed, and only the better ones retained. Any surviving overstory aspens should be removed at this time.

5. Special Treatment Areas.

a. Areas developed for intensive recreation use. A silvicultural system is usually not required to manage the timber on these areas. The timber will be cut or treated only when such is necessary to meet the requirement of the recreation plan for the specific area, protect the public, or protect adjacent commercial stands of timber from insects or disease.

b. Areas planned for future intensive recreation development. Areas scheduled for development during the next 10 years will not be included in the cutting budget. Any required cutting will be in accordance with caption "a".

Only those areas for which the development is scheduled far enough in the future to insure satisfactory site condition prior to development will be included in the cutting budget.

c. Travel influence zones, waterfront and streamside zones, and scenic areas. Lighter cuts in the form of groups, small patches, or narrow strips will normally be prescribed when cutting is necessary for sanitation or reproduction purposes in dispersed areas. The areas will be of such a size and location as to maintain a pleasing appearance to the extent possible and still meet the sanitation and regeneration needs. A pathological rotation will control the period over which these stands will be cut.

Intermediate cuts, including cleaning, thinning and improvement cuttings, may be applied to stands below rotation age. The intermediate cutting should be scheduled along with such cutting in adjacent stands.

Salvage Cuts - Snags will be cut when and where necessary for the protection of the public.

6. Protection measures.

Fire - Normal fire protection should suffice.

Diseases - The wood rots and the cankers are the most important diseases. According to past studies, decay losses should not be excessive within the rotations established. Since the trees are very susceptible to decay, injured trees should be cut unless they are to be harvested within 20 years.

The important cankers are the black canker of aspen, Hypoxylon canker, and the sooty-bark canker. Little is known about the black canker,and the Hypoxylon canker has not been common in the Rocky Mountains. The only protection recommended is to remove infected trees as part of all stand treatments.

The sooty-bark canker is considered to be the most dangerous one. When conditions are right it can attack and kill all newly injured trees in a stand. The reason for this is unknown. However, it enters through injuries in the bark and commonly attacks only trees 60 years or older. In stands where sooty-bark canker is present, exceptional care should be exercised in the first cutting of two-storied or uneven-aged stands to avoid bark injury to trees that are to be reserved for a second cut. Little is gained by cutting infected trees as the fungus continues to fruit on the dead wood for many years.

Insects - Significant infestations of Great Basin tent caterpillars should be reported to the Regional Forester. Many species of wood borers tend to reinfest the trees from which they emerged. Such trees become brood trees and should be felled.

Mammals - Damage from mammals is usually important only to sprouts in regenerating areas. Sheep should be kept out of regenerating areas until the sprouts are four feet tall, usually not more than three years. Cattle and game animals are not likely to cause much damage if the range is properly stocked.

Mice cause severe damage only in years of population peaks. Heavy mouse damage should be reported to the Regional Forester.

B. Noncommercial aspen sites. To perpetuate aspen on sites IV and V, cutting at or before 50 years of age may be necessary. Suckering may occur naturally on some sites without cutting, but reproduction will be more certain if mature stands are clear cut. Cutting during the dormant period induces maximum sprouting.

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Yield Table

The only yield information available is taken from U.S.D.A. Bulletin 1291, Baker, F.S., "Aspen in the Central Rocky Mountain Region," dated February 20, 1925.

Empirical Yield Table for Even-aged Aspen Stands

SITE I

Age	Entire Stand: Trees per Acre	Main Stand[1]: Trees per Acre	Avg. D.B.H. In.	Basal Area Sq.Ft.	Volume Per Acre[2]: Total[3] Cu.Ft.	Cord-wood[4] Cu.Ft.	Mine Props[5] Lin.Ft.	Saw-timber[6] Bd.Ft.
30 years	1,600	710	--	76	300	--	--	--
40 years	1,300	1,000	4.5	124	1,350	850	--	--
50 years	960	750	5.3	136	2,250	1,550	3,400	600
60 years	750	610	6.1	144	3,000	2,200	6,200	2,000
70 years	610	520	7.0	148	3,550	2,750	8,700	4,800
80 years	500	450	7.8	154	4,050	3,250	10,700	6,800
90 years	410	380	8.7	161	4,500	3,600	10,700	9,000
100 years	340	360	9.5	166	4,850	4,000	9,000	11,000
110 years	290	290	10.4	172	5,100	4,300	6,000	13,200
120 years	250	250	11.2	177	5,350	4,600	4,200	15,400
130 years	220	220	12.1	181	5,600	4,900	2,800	17,400
140 years	200	200	13.0	184	5,950	5,150	1,800	19,600
150 years	190	180	13.8	186	6,100	5,400	1,000	21,600

1/ Trees more than 4 inches in diameter breast high.
2/ Gross volume without cull factor of any kind.
3/ Includes total volume of all trees more than 4 inches in diameter breast high.
4/ Includes total volume of all trees 6 inches diameter breast high and over, to a top diameter limit of 5 inches.
5/ Includes all trees 7 inches to 11 inches in diameter at breast height. Merchantable length taken to 5 inches inside bark in tops.
6/ Includes all trees 10 inches and over diameter at breast height. Merchantable length taken to a 9-inch diameter limit in tops.

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SITE II

Age	Entire Stand: Trees per Acre	Main Stand 1/: Trees per Acre	Avg. D.B.H.	Basal Area	Volume Per Acre 2/: Total 3/	Cord-wood 4/	Mine Props 5/	Saw-timber 6/
			In.	Sq.Ft.	Cu.Ft.	Cu.Ft.	Lin Ft.	Bd.Ft.
30 years	5,600	220	--	14	--	--	--	--
40 years	3,400	650	4.0	78	500	150	--	--
50 years	1,200	900	4.8	114	1,350	750	--	--
60 years	940	710	5.4	124	2,100	1,300	3,500	600
70 years	730	580	6.1	132	2,750	1,750	6,500	2,000
80 years	580	490	6.8	140	3,250	2,200	8,500	3,400
90 years	460	400	7.5	146	3,650	2,600	9,500	4,800
100 years	380	330	8.2	152	4,000	2,900	8,000	6,200
110 years	320	270	8.9	158	4,300	3,200	4,500	7,600
120 years	270	240	9.6	162	4,550	3,400	2,700	9,000
130 years	240	160	10.2	166	4,750	3,650	1,500	10,400
140 years	210	110	10.9	170	4,900	3,850	600	11,800

SITE III

50 years	2,500	700	4.1	72	500	200	--	--
60 years	1,120	800	4.7	104	1,300	550	600	--
70 years	850	650	5.3	114	1,950	950	4,000	150
80 years	670	520	5.8	122	2,500	1,250	6,400	1,000
90 years	530	410	6.5	128	2,950	1,600	7,900	1,600
100 years	440	320	7.1	134	3,300	1,850	5,300	2,200
110 years	360	240	7.7	138	3,600	2,100	2,400	2,800
120 years	310	170	8.3	142	3,850	2,300	1,200	3,600
130 years	260	100	8.9	146	4,050	2,500	400	4,200

SITE IV

60 years	1,430	740	4.2	70	400	50	--	--
70 years	1,030	700	4.8	92	1,000	400	1,800	--
80 years	800	550	5.3	104	1,600	750	4,000	200
90 years	620	430	5.8	110	2,050	1,050	3,500	300
100 years	500	320	6.3	116	2,400	1,300	1,800	400
110 years	410	220	6.9	120	2,700	1,550	700	600
120 years	340	140	7.4	124	2,950	1,700	100	800

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