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ROTATIONS

John R. Jones and Wayne D. Shepperd

The rotation, in forestry, is the planned number of years between formation of a crop or stand and its final harvest at a specified stage of maturity (Ford-Robertson 1971). The rotation used for many species is the age of culmination of mean usable volume growth [net mean annual increment (MAI)]. At that age, usable volume divided by age reaches its highest level. That volume varies according to standards of usability. For example, if the pulpwood market accepts the entire bole plus branches, then the MAI of aspen grown in the Lake States for pulpwood would culminate between 20 and 30 years (Benson and Einspahr 1972, Einspahr and Benson 1968, Ek and Brodie 1975, Perala 1973).

In the West, however, most markets have been for larger logs (sawlogs and veneer logs), and the situation is complicated by the frequency of two-aged and uneven-aged stands. Also, most aspen in the West lives longer and grows more slowly than aspen in the Lake States (fig. 1). For management purposes, only even-aged stands are considered here; it is the only aspen stand structure suitable to manage for wood products.



Figure 1.—Many existing aspen stands in the West are at or beyond rotation age.

Tables and equations for net MAI of aspen are being developed for application in the West (fig. 2).¹ Gross MAI, in board feet, culminates at about 140 years (Baker 1925); but, gross MAI is not a suitable criterion for setting aspen sawtimber rotations. Decay becomes important from 80 to 90 years of age and older (Baker 1925, Meinecke 1929). They suggested rotations of 70 to 110 years, and usually not more than 80 to 90. At that time, Meinecke (1929) found that stands older than 80 years commonly were fire scarred and had serious decay; fire scars were the infection sites for 68% of all cull resulting from decay. (For a discussion of decay in aspen, see the DISEASES chapter.)

In Colorado, Davidson et al. (1959) studied decay in stands 41 to 170 years old. Decay differed greatly among similar aged stands on the same site class. Some of that variation was a result of decay associated with fire scars, especially in the older stands. Some variation also could be attributed to the absence or rarity in some stands of the principal decay fungus, *Phellinus tremulae*. Shepperd (1981) found rot to be present in about 80% of 140 aspen stands in Colorado and southern Wyoming; but, it affected only 20% of the stems in those infected stands. Incidence of rot was significantly greater in stands older than 100 years.²

Meinecke (1929) stated that fire protection would allow longer rotations for aspen. Currently, few stands in the 80- to 90-year age class are fire scarred, and many are just beginning to have appreciable sawlog volume. They will become merchantable in another 20 years, if they remain without serious decay. The best stands of aspen sawtimber in the West are older—many beyond 110 years. These are stands with many trees containing logs of veneer quality. Although some trees are cull because of, or have some volume loss caused by basal rot, overall the stems are sound.

In the past, considerable attention has been given to the volume of waste resulting from aspen decay, with little mention of the volume wasted in trees too small to use at the 80- to 90-year rotation age. If the stand is cut then, all trees must be felled regardless of merchantability, or they become a major deterrent to the development of a new even-aged stand. Those small trees, although sound, effectively are cull, too. They represent an appreciable portion of the biomass in 80- to 90-year-old stands. Many have the potential of becoming merchantable sawlogs in

¹An aspen subroutine for the even-aged stand growth model RMYLD has been completed at the Rocky Mountain Station in Fort Collins, Colo. This subroutine can predict the growth of aspen in the Rocky Mountains under several management strategies and rotation lengths.

²Data on file at the Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colo.

another 10 to 20 years. Typically, there is a period beyond age 90 when ingrowth into merchantable size classes and into higher value classes is greater than the increase in decay losses. That ingrowth may make the difference in a stand being salable or not salable for sawlogs.

Considering the decay figures of Davidson et al. (1959), and allowing for their inclusion of fire scarred stands, a tentative sawlog rotation of 110 years is suggested for stands with site indexes greater than 75 feet, and 120 years for stands with site indexes between 60 and 75 feet. Stands with site indexes less than 60 feet are unlikely to become merchantable for sawtimber. These rotations should be applied with flexibility and good judgment. External indications of disease might dictate cutting sooner. If diameter growth remains good at rotation age, and conks or serious cankers are minor, the stand may be retained longer, especially if many trees are growing into merchantable or veneer classes.

The merchantability standards and, thus, the rotation ages, change appreciably when other fiber products, such as waferboard, are considered. Stems down to a 3-inch (7.5-cm) top can be debarked, chipped, and effectively used as the raw material for waferboard or similar products (see the WOOD UTILIZATION chapter). Also, the minimum log length is 8 feet (2.5 m), which permits removal of much rot and defect in the harvesting process. Crook, sweep, and other defects common to sawlogs are not a problem, nor are stands containing a wide distribution of stem diameters.

Because stem size does not seriously limit utilization of aspen for waferboard, rotation ages can be shortened to as little as 40 or 50 years, depending upon the site indexes.

However, this type of management is unlikely in most situations. A realistic approach, considering the requirements for other resources as well as the multiple product markets that are expected to develop, would be an intermediate rotation of 80 to 100 years. This would produce both waferboard chips and sawlog volumes in stands still young and healthy enough to avoid large volume losses resulting from decay.

On sites without significant potential for fiber production, volume growth may not be a factor in setting rotation ages. To some extent, this also may be true of some productive sawtimber sites, especially those managed for multiple uses. For example, some stands, or clones

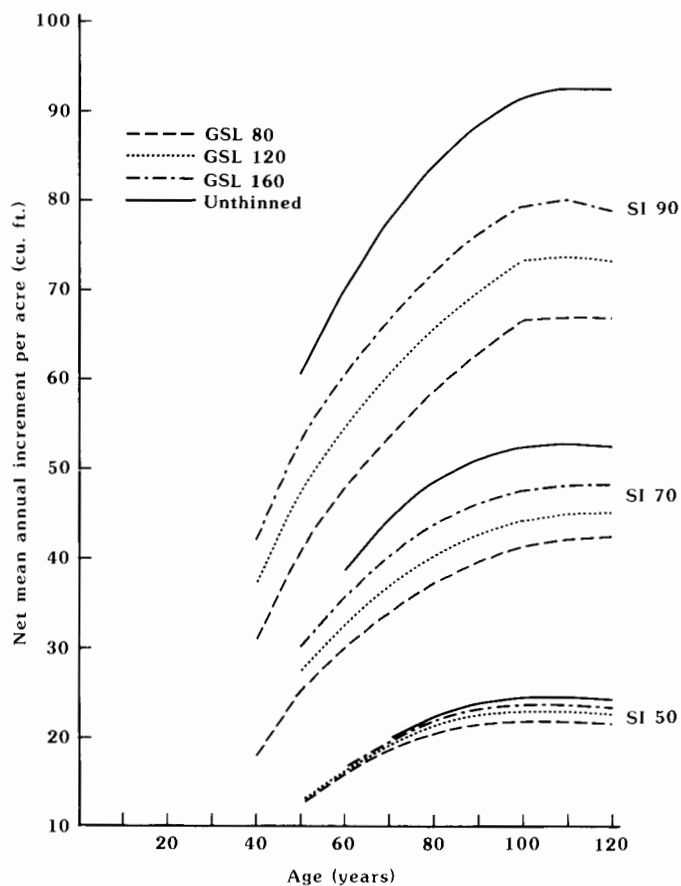


Figure 2.—An RMYLD simulation of net mean annual increment for thinned and unthinned Rocky Mountain aspen stands at three site index classes. Growth of thinned stands was based on a single precommercial thinning at age 20.

within stands, might be burned, sprayed with herbicide, or otherwise killed at rotations of 30 or 40 years to provide maximum forage production for wildlife. Conversely, some stands may be retained until they are seriously deteriorating, at perhaps 130 years, to provide better forest scenery, particularly along roads. Some esthetically pleasing stands that are regenerating successfully without treatment may be continued with no rotation at all. Still others may be managed under an uneven-aged system using a group selection cutting method to provide stands with vertical canopy diversity for wildlife habitat or esthetic purposes.