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Deferment Cutting in Central Appalachian Hardwoods:

An Update

Deferment cutting is designed to regenerate a variety of high-quality hardwood species and promote a two-age stand structure for aesthetic, wildlife habitat, and other non-timber benefits. Basal area is reduced enough so that it resembles a seed-tree or shelterwood practice in that some overstory trees are retained while all other trees are cut (Figure 1). However, in deferment cutting the residual trees are not cut once the reproduction becomes established as in even-age practices. Instead, the harvest of the residual trees is deferred until new reproduction is between 40 and 80 years old, generally one-half to a full sawtimber rotation. The result is a two-age stand structure. Once the two-age stand structure is established, deferment cuts can be repeated at intervals of 40 to 80 years to maintain this condition for many years. Silviculturists also use terms such as clearcutting with reserves or irregular shelterwood to describe practices that promote a two-age stand structure.

Silvicultural systems that promote a two-age stand structure have been initiated on national forests, state forests, industrial forests and to a lesser degree on nonindustrial private forests in many eastern states. A similar practice called "insurance silviculture" was applied in Pennsylvania to retain a seed source in the event of a regeneration failure (Bennett and Armstrong 1981). In most cases, two-age silvicultural methods were employed to regenerate a variety of species, particularly those that are shade-intolerant, and to mitigate the perceived negative visual impacts of clearcutting. Similar to clearcut stands, natural regeneration that follows two-age regeneration methods includes a variety of both shade-tolerant and shade-intolerant commercial hardwoods (Miller and Schuler 1995). Unlike clearcutting, however, the presence of residual overstory trees improves aesthetics and maintains a more diverse vertical stand structure that may benefit certain wildlife species (Pings and Hollenhorst 1993). As the new reproduction develops beneath the large overstory residuals, the stand has two distinct height strata. These strata provide a diverse habitat for songbirds that forage in high canopy trees (Wood and Nichols 1995), as well as those that require a brushy cover characteristic of a young even-age stand (DeGraaf et al. 1991). Deferment cutting also provides an opportunity to retain species that produce hard mast for wildlife food.

Though wildlife habitat and aesthetic issues also are important, this report focuses on two aspects of stand development after deferment cutting: (1) growth and development of the residual trees, and (2) abundance and species composition of reproduction that develops after cutting. This paper summarizes research results on deferment cutting as it has been applied in central Appalachian hardwoods on the Monongahela National Forest (MNF) since 1979. Results are presented from a recent study of 20 operational deferment cuts applied in stands throughout the MNF since 1991.

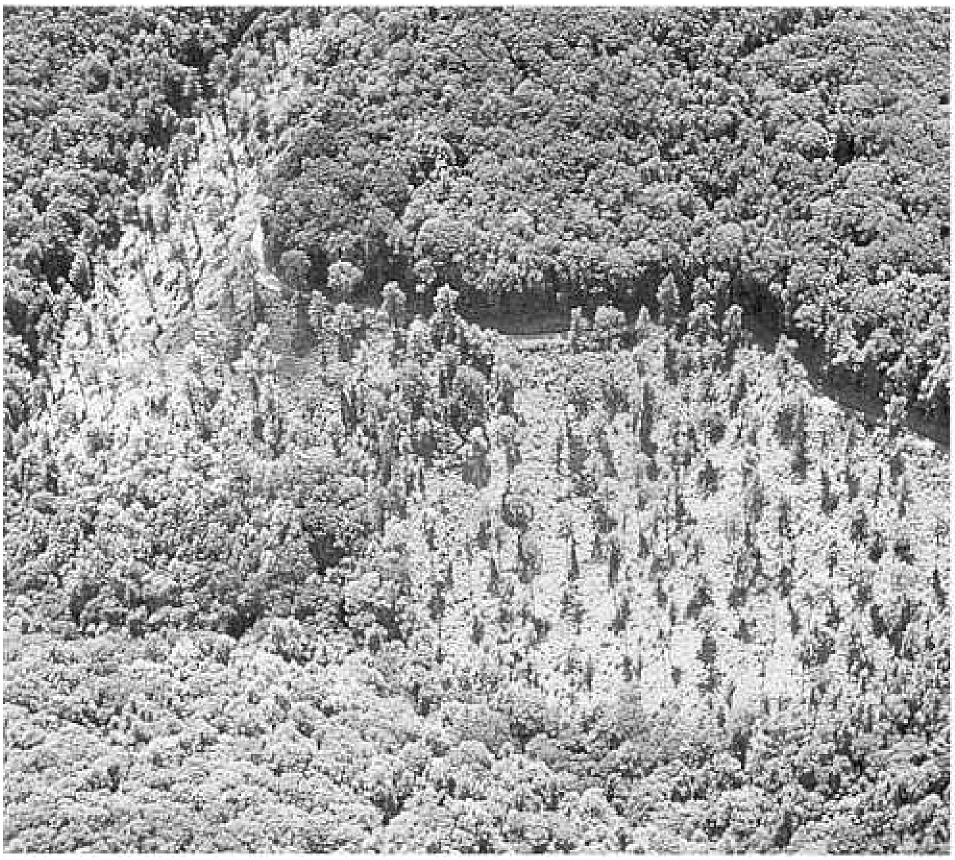
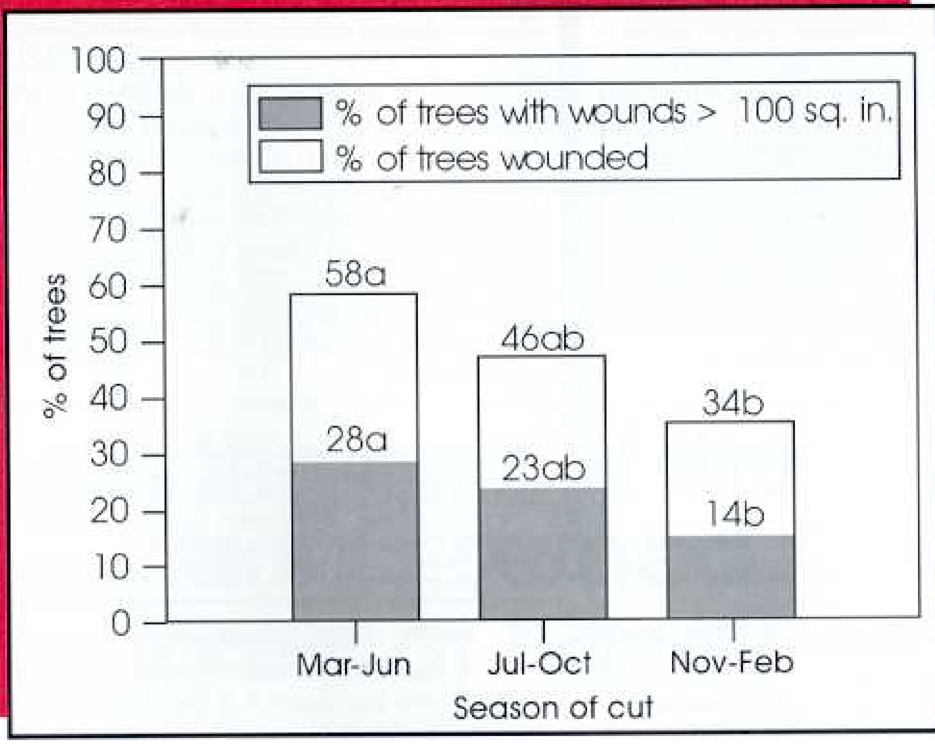


Figure 1. Three years after deferment cutting in central Appalachian hardwoods. The residual stand contained 15 desirable codominant trees per acre, the remaining merchantable sawtimber trees were removed, and all other stems 1.0 inch dbh and larger were cut to prepare the site for new reproduction.

Figure 2.
Mean percent of residual trees with logging wounds. For bars of the same shade, means followed by the same letters are not significantly different (P>0.10) using Tukey-Kramer HSD.



OPERATIONAL DEFERMENT CUTS

In 1996, data were collected on 20 two-age stands on the MNF that had received deferment cuts two to five growing seasons prior to the study. This survey was conducted to assess current conditions and the implications of deferment cutting on future species composition and wood product quality. Thus, changes in residual tree quality and reproduction presented here are preliminary results for the first two to five years after treatment and do not necessarily represent the long-term implications of this practice. Data collected for residual trees included species, diameter breast height (d.b.h.), crown class, number of epicormic branches on the bottom two 16-foot logs, size of wounds and tree grade (Hanks 1976). An initial tree grade was estimated based on visible tree characteristics minus new wounds and new epicormic branches deemed to have resulted from recent logging. Data collected for reproduction included species and height for each woody stem on 0.001-acre plots located along systematic grids in each stand. Thirty plots, on average, were located on each stand.

Survival and Quality of residual Trees

Tree grade, epicormic branches and logging damage were evaluated for a total of 768 individual trees representing nine commercial species. An average of 8 percent of residual trees had died since the stands were cut. In general, deferment cutting did not result in significant grade changes in the first 2-5 years after treatment. Among large sawtimber (17.0 inches d.b.h. and larger) 11, 8 and 3 percent of white oak, black cherry, and northern red oak, respectively, exhibited grade reductions due to logging wounds or epicormic branches. Large sawtimber of other species did not exhibit grade reductions. Among small sawtimber (11.0-16.9 inches d.b.h.) grade reductions were more common compared with large sawtimber (Table 1). The development of epicormic branches was most prevalent on white oak. Suppressed and intermediate trees developed more epicormic branches and had more reductions in tree grade compared with codominant and dominant trees. Considering all of the 20 stands, 45 percent of residual trees were wounded during logging, 21 percent of trees had severe wounds larger than 100 in.^{2}, and 24 percent had smaller wounds. The remaining 55 percent of residual trees were not wounded. However, the number of trees wounded and the severity of wounds was related to the months in which logging occurred (Figure 2). Logging damage was greatest during the spring (March-June) and least during the dormant season (November-February).

continued on page 30

Table 1.
Percent of trees reduced in grade due to logging wounds or epicormic branching after deferment cutting.[a]

	Small sawtimber (12-16 inches d.b.h.)				Large sawtimber (18 inches d.b.h. and larger)			
Species	n	Number of trees	%	95% CI[b]	n	Number of trees	%	95% CI
Yellow-poplar	23	1	4	<1-34	11	0	0	0-46
Black cherry	59	3	5	<1-11	38	3	8	1-22
Northern red oak	43	2	5	<1-19	32	1	3	<1-16
White oak	19	0	0	0-20	9	1	11	<1-48
Chestnut oak	22	0	0	0-11	15	0	0	0-33
Sugar maple	61	4	7	<1-12	20	0	0	0-17
Red maple	49	1	2	<1-12	10	0	0	0-49
White ash	41	4	10	<1-18	20	0	0	0-17
American basswood	17	0	0	0-26	3	0	0	0-71

a, Data from 20 stands on the MNF where operational two-age cutting was applied.
b, Confidence interval.

Table 2. Summary of small and large reproduction present 2-5 years after deferment cutting by forest cover type.[a]

Species[b]	Beech-Cherry-Maple		Mixed Appalachian Hardwoods		Mixed Oaks	
	Very small[c]	Small[d]	Very small	Small	Very small	Small
	----number of stems/acre (% of plots stocked)----					
Birches	8,464(62)	1,989(31)	3,502(39)	2,324(24)	2,886(25)	137(9)
Maples	1,717(50)	641(16)	1,116(39)	516(19)	2,259(50)	556(14)
Red oaks	9(1)	3(1)	410(24)	203(11)	582(18)	100(7)
White oaks	0(0)	0(0)	80(8)	254(1)	103(6)	140(3)
Am. beech	2,268(55)	4,591(63)	83(4)	162(4)	20(1)	0(0)
Black cherry	6,357(68)	3,825(44)	820(25)	466(14)	40(2)	45(2)
Hemlock	68(3)	0(0)	0(0)	4(1)	0(0)	0(0)
White ash	38(3)	30(1)	829(22)	499(12)	30(30)	0(0)
Yellow-poplar	404(12)	70(4)	3,271(35)	62(3)	367(13)	18(2)
Am. basswood	0(0)	0(0)	4(1)	12(1)	0(0)	0(0)
Others	305(16)	68(5)	185(14)	396(17)	299(16)	520(20)
Total	19,628	11,217	10,300	4,898	6,586	1,516

a, Data from 20 stands on the MNF where operational applications of deferment cutting were applied.
b, Birches include sweet and yellow birch; maples include red and sugar maple; red oaks include northern red, scarlet and black oak; white oaks include white and chestnut oak; others include blackgum, aspen and cucumbertree.
c, Very small reproduction = all stems < 1.0 ft. in height
d, Small reproduction = stems ≥ 1.0 ft. in height and < 1.0 inch d.b.h.

continued from Deferment Cutting *page 29*

Reproduction

Stands were grouped by three forest cover types before regeneration results were summarized: beech-cherry-maple at the higher elevations in the Allegheny Mountains, mixed Appalachian hardwoods in the coves of the Allegheny Mountains, and mixed oaks in the Ridge and Valley province east of the Allegheny Front. Most of the reproduction present on the survey plots was less than 1.0 ft tall (Table 2). In the beech-cherry-maple stands, reproduction was dominated by American beech, black cherry and the birches, though many other species also were present. The mixed Appalachian hardwood stands contained the greatest diversity of species, though birches, maples, black cherry and white ash were most abundant. Reproduction in the mixed-oak stands was dominated by red and sugar maple, birches and northern red oak. These results are consistent with other studies of two-age and even-age regeneration practices (Trimble 1973; Miller and Schuler 1995; Beck 1986).

The total number of noncommercial stems was small, representing only 5, 12, and 28 percent of stems present in the beech-cherry-maple, mixed Appalachian hardwood, and mixed oak cover types, respectively. Noncommercial stems included striped maple, dogwood, pin cherry, sassafras, serviceberry and American hornbeam. These stems are not expected to interfere with the growth and development of commercial species (Miller and Schuler 1995).

Currently the data indicate that these stands have adequate density and distribution of desirable reproduction. However, it is too soon to predict the eventual species composition. As these stands continue to develop, the trees in the new age class will form a height stratum distinct from the larger overstory trees left after logging. Stems present when data were collected will compete for crown position until the canopy of the new age class closes from 10 to 15 years after logging. Trees that attain a codominant position at crown closure will determine the species composition of these stands for many years (Trimble 1973).

SUMMARY AND RECOMMENDATIONS

Experience with deferment cutting since 1979 indicates that desirable reproduction can be established and will develop into an acceptable new crop for sustained production of many forest benefits. The species composition includes a variety of shade-intolerant and shade-tolerant species that is similar to that observed after clearcutting (Trimble 1973; Beck 1986; Miller and Schuler 1995). Cultural practices such as crop-tree release can be applied to stems in the new age class once the canopy closes to favor the growth and development of the most desirable stems, such as northern red oak.

Residual basal area in experimental deferment cuts applied between 1979 and 1983 averaged 20 ft^2/acre. In more recent operational deferment cuts applied on the MNF since 1991, residual basal area averaged 39 ft^2/acre. While residual trees in the experimental deferment cuts were potential high-quality sawtimber, residual trees in the operational deferment cuts also included mast and den trees to help meet wildlife habitat objectives. In practice, deferment trees may be selected by many criteria to help the forest manager achieve a range of objectives.

Where residual tree quality is a concern, avoid leaving trees in weaker crown positions or trees that show evidence of stress before treatment. For most species, the strong codominants will not suffer grade reductions after deferment cutting. To reduce logging damage, try to employ a reliable logger and conduct operations during the dormant season from November through January. To reduce windthrow, avoid leaving trees above skid roads near the cut bank where roots are disturbed.

Residual basal area should range from 20 to 40 ft^2/acre to meet regeneration goals. However, if small sawtimber or poles are retained, maximum residual basal area will be reduced to allow for crown expansion as the overstory trees mature. Cutting all stems 1.0 inch and larger, other than the desired redisual trees, is also important. Cutting these stems during logging eliminates low shade that interferes with regeneration and provides suitable growing conditions for the valuable shade-intolerant species.

Two-age regeneration harvests should be applied no more frequently than one-half the recommended sawtimber rotation for local conditions. In the central Appalachians, economic sawtimber rotations are 90, 80 and 70 years for northern red oak SI 60, 70 and

continued on page 68

continued from Deferment Cutting *page 31*

80, respectively. As a result, two-age harvests could be applied every 40-50 years. A concern with relatively frequent harvests is that many large poles and small sawtimber need to be cut at short intervals to provide adequate light for regeneration of a new age class. At age 40, even-aged stands in the region contain 75-100 codominant stems per acre, with an average d.b.h. of only 10 inches. To maintain a two-age stand structure, 20-30 of the best codominant trees need to be retained to reach maturity, while the remaining trees will be cut. A disadvantage of short cutting intervals is that many cut trees will be removed at a time when their potential growth and value increase are at a maximum.

As two-age regeneration methods are employed to meet emerging forest management objectives, additional research is needed to better understand the implications of this practice. It is important to define linkages among plant and animal communities that may be affected by maintaining two vertical strata of woody vegetation over extended periods. For example, additional studies are needed to determine the relationship between stand density and structure on game and nongame wildlife communities. And because the forest is always changing, more research is needed to define the susceptibility of residual trees to insect and pathogen attacks over much longer periods. This practice may also affect product options. Residual trees grow rapidly after deferment cutting and such growth rates may influence product quality and utilization options.

Due to differences in the timing and frequency of harvest cuts, economic returns from silvicultural alternatives are seldom directly comparable on the basis of returns from a single entry. However, estimates of harvesting costs and roundwood values suggest that implementing deferment cuts versus conventional clearcuts can reduce net cash flows from the initial regeneration cuts by $459-$1,171 per acre, or 18-26 percent, depending on site quality and roundwood price levels (Miller and Baumgras 1994; Baumgras et al. 1995). These revenue reductions were estimated for fully stocked stands at age 80 years, and reflect the assumption that the deferment cutting residual trees were low-risk dominants and codominants. These residual trees can make significant contributions to economic returns from future harvests, but diminish short-term returns to provide the desired non-timber amenities.

Two-age methods show promise for application in the central Appalachian hardwood region. With additional information from long-term observations, this practice and its many potential variations may provide forest managers with an ecosystem management tool for the future.

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