From A
Tc

ABSTRACT—A 40-year-old clearcutting, originally made as an example of destructive logging, now supports one of the best mixed hardwood stands on the Bent Creek Experimental Forest. Such desirable intolerants as yellow-poplar provide potential for timber; some high- and low-quality oaks provide timber and wildlife values; and the entire young stand has a pleasing appearance.

Charles E. McGee

THE AUTHOR is principal silviculturist, Southeastern Forest Exp. Sta., U.S. Forest Serv., Asheville, N.C.

Fig. 1. The study area in 1931 just before piles of slash were burned.

Settlers moved into the Southern Appalachian mountains in the early ot mid-1800's. They cleared the better lands for farming, and used the timber to build houses, barns, and fences. In the ensuing years the farm woodlots provided fuelwood and timber to maintain the settlers' farm buildings. By the early 1900's heavy commercial logging was in full swing. High grading—taking only the best trees—was common, and blight practically eliminated the chestnut, one of the fastest growing timber trees. The forest deteriorated until by 1930 culls and otherwise defective, low-quality trees dominated a large part of the southern Appalachian hardwood forests.

To find a cutting technique that could be used to rehabilitate these rundown stands, a study was started in 1931 on the Bent Creek Experimental Forest near Asheville, N.C.[1] Included in the test was a complete clearcutting of 6 acres (*Fig. 1*). Fortunately this stand remained intact and is identifiable. (Other treatments included cutting to a diameter limit, a selection cut, conversion of a pine-oak stand to pine standards with hardwood coppice, and a control. Unfortunately, these treatments are no longer identifiable because the area containing them has been used for other purposes.) Perhaps the details of stand development in the clear-

Defective Hardwood Stand Multiple Use Opportunity

cutting will dispel some fears about management in the southern Appalachians—and point out some of the multiple-use opportunities that have resulted from this cutting of 40 years ago.

Before Clearcutting

The cutover area is on a steep (50 percent) northwest-facing slope where elevation ranges from 2,000 to 2,300 feet. For the sake of discussion the area can be separated into an upper, middle, and lower slope, but it is obvious that a stand of 6 acres could not be efficiently managed in such tiny units. The soil is a sandy loam of the Cecil series; as described in 1931, it is very thin, has numerous large rock outcroppings, and, with the exception of the lower slope, is very dry. It was classed as moderately poor and had never been farmed.

The area was originally mapped as a chestnut-chestnut oak type, but only a few scattered chestnut trees remained in 1931 because of the blight. Repeated high grading had further depleted the stand so that mostly inferior forest remnants remained. Large, overmature wolf trees made up 22 percent of the volume. Only a few young and vigorous trees grew around moist places on the lower slope, and the stand was classed as uneven-aged. It contained 1,315 cubic feet and 316 trees per acre; the defective condition of most of the trees reduced log yield to only 700 board feet per acre.

Before the 1931 clearcut, the stand included 13,160 stems less than 1.1 inches d.b.h. About 8,000 stems per acre were classed as desirable for timber production and 3,000 of these were judged free-to-grow. Oaks predominated: Chestnut oak at 20 percent of the cubic-foot volume and 14 percent of stems over 1.1 inches d.b.h.; black oak at 17 percent of the volume

[1] J. H. Buell. Report on clearcutting in unit C-1 and the establishment of plot 38. A study plan. Bent Creek Experimental Forest, 1930-1931.

Fig. 2. Forty years later the upper slope has a slow growth rate but offers an esthetically desirable species mix.

and 2 percent of the stems; and white oak at 11 percent of the volume and 6 percent of the stems. Yellow-poplar, white ash, black walnut, and black locust each made up about 2 percent of the volume and 2 percent of the stems. Hickory, sweet birch, and yellow pine accounted for 4 to 6 percent each of volume and number of stems. Nontimber species—dogwood, sourwood, and red maple—were important in number of stems. Portions of the lower slope were covered with a heavy understory of alder, willow, and grapevine. The middle slope had a heavy growth of laurel and rhododendron 10 to 15 feet tall. Farther up the slope the underbrush was less dense, consisting of *Vaccinium* and other ericaceous shrubs.

Stand Treatments

In 1931 the study area was cut as an example of so-called destructive logging. All trees were felled and removed, small brush and reproduction were cut with a scythe, and the slash was piled and burned.

Fourteen years later, in 1944, Jemison (*1*) found the clearcut stand to contain 47 square feet of basal area per acre. Most of the overstory was desirable, but 7 square feet of material in the overstory and 6 square feet in the understory were not desirable for timber production. Cleaning and thinning were imposed to remove potential wolf trees, multiple sprouts, and less desirable stems. As a result, competition in the upper crown was reduced materially.

Jemison also reported, in comparing the three types of cutting, that clean cutting had shown the greatest increase in basal area. The selection cut ranked second in basal-area growth, and was beginning to show marked superiority in quality over the diameter-limit cutting and the check area. He concluded that the young coppice stand on the clearcut area showed considerable promise of developing into a healthy, productive condition.

Fig. 3. *(top)* **The middle slope is growing at a fair rate and has a wide variety of trees and understory species valuable for both timber and wildlife habitat.**

Fig. 4. *(bottom)* **The size and distribution of the trees on the lower slope emphasize the site's tree-growing potential.**

In 1952 Wahlenberg (*2*) reported on the advantages and disadvantages of four of the treatments tested in the original study. He concluded that each cutting method could be suited for different sets of operating conditions. As advantages of clearcutting, Wahlenberg listed small investment costs because of low-level growing stock, rapid cubic-volume growth, high percentage return, and opportunity to convert mishappen stems into seedling sprouts of better quality. Disadvantages were: sacrifice of immature stems that could develop into good growing stock, low returns realized per unit of volume cut, limited markets for small trees, and exposure of the site to possible deterioration.

In 1958 a light commercial thinning of the clearcut area removed 3 cords of wood (predominantly from multistemmed clumps and defective trees) and 40 locust posts per acre.

After 40 Years

Today the clearcut area is a pleasant place to visit. The soil is still thin and rock outcroppings are present, but there is no visual evidence of appreciable soil movement or site degradation during the 40-year management period. The trees, mostly of coppice origin, are tall and straight and well distributed over the area. Where it once supported a stand of cull, defective, and overmature timber, the site is ready to be managed for timber, wildlife, and esthetics.

Although many of the trees are either stump sprouts or seedling sprouts, the dominant stand differs considerably from the group of trees removed in 1931. Complete removal of the overstory and understory has

Table 1. Species Composition 40 Years After Clearcutting in the southern Appalachians

Species	Upper slope			Middle slope			Lower slope		
	1-4 inches d.b.h.	5-12 inches d.b.h.	12+ inches d.b.h.	1-4 inches d.b.h.	5-12 inches d.b.h.	12+ inches d.b.h.	1-4 inches d.b.h.	5-12 inches d.b.h.	12+ inches d.b.h.
	number per acre								
Black cherry (*Prunus serotina*)	0	0	0	0	0	0	6	0	0
Black locust (*Robinia pseudoacacia*)	28	44	0	7	23	0	0	0	0
Black oak (*Quercus velutina*)	17	11	0	0	6	0	4	0	0
Chestnut oak (*Quercus prinus*)	50	59	0	94	75	0	11	6	0
Dogwood (*Cornus florida*)	491	0	0	141	0	0	177	0	0
Hickory (*Carya* spp.)	95	5	0	90	0	0	24	0	0
Laurel (*Kalmia latifolia*)	62	0	0	162	0	0	0	0	0
Northern red oak (*Quercus rubra*)	0	7	0	0	19	0	5	12	1
Red maple (*Acer rubrum*)	102	0	0	112	5	0	74	0	0
Rhododendron (*Rhododendron maximum*)	0	0	0	31	0	0	0	0	0
Scarlet oak (*Quercus coccinea*)	24	32	0	0	14	0	0	0	0
Sweet birch (*Betula lenta*)	0	0	0	51	13	0	68	32	0
White ash (*Fraxinus americana*)	68	21	0	33	6	0	39	0	0
White oak (*Quercus alba*)	36	23	0	16	0	0	9	0	0
Yellow-poplar (*Liriodendron tulipifera*)	0	0	5	21	15	4	12	32	18
Miscellaneous shrubs[1]	114	0	0	289	0	0	509	0	0
Miscellaneous trees[2]	114	0	0	69	0	0	489	38	2

[1] Miscellaneous shrubs include alder (*Alnus* spp.), azalea (*Rhododendron* spp.), spicewood (*Lindera benzoin*), witchhazel (*Hamamelis virginiana*).

[2] Miscellaneous trees include sourwood (*Oxydendrum arboreum*), serviceberry (*Amelanchier* spp.), black walnut (*Juglans nigra*), butternut (*Juglans cinerea*), blackgum (*Nyssa sylvatica*).

favored the establishment of such intolerant species as yellow-poplar, sweet birch, northern red oak, and black locust (*Figs. 2, 3, and 4*).

The sprout origin of most of the stand introduces the question of tree vigor and stem soundness. Two species in this stand, yellow-poplar and sweet birch, show little sign of butt rot or poor stem form; on the other hand, some of the oaks have problems. About half of the scarlet oak has either butt rot or abnormal boles likely to become infected with rot in the next several years. About one-third of the chestnut oak, white oak, and northern red oak is either infected or likely to be soon. The degree of infection ranges from severe cases that will affect longevity of the tree to cases that will affect only quality of the wood. Most severely infected trees can be removed in the next thinning.

Upper Slope—Site index on the upper slope averages 80 for yellow-poplar, 70 for ash, and about 60 for the oaks. The basal area is 82 square feet per acre and is made up mostly of 5- to 8-inch trees. There are 22 cords and 864 board feet, or 1,922 cubic feet, per acre.

Chestnut oak and scarlet oak dominate the stand in the upper canopy, while dogwood is the most frequently occurring species (*Table 1*). The 491 dogwood stems per acre provide wildlife food and a beautiful flower in the spring but are a source of annoyance to anyone who attempts to regenerate the stand to timber-producing trees.

The species composition on the upper slope is somewhat similar to that of the stand removed in 1931. Except for five hardy yellow-poplar per acre and some black locust, the intolerants have not been able to become established on this dry and demanding upper slope. Many black locust have died and many of the others probably will in the next five years.

Middle Slope—The middle slope occupies the steepest portion of the cutover area and has most of the large rock outcroppings. Site index averages 90 for yellow-poplar and 75 for the oaks. Basal area is 58 square feet per acre, almost all in 5- to 12-inch trees. This slope supports 1,320 cubic feet per acre of merchantable timber, consisting of 16 cords of pulpwood and 277 board feet.

A broad mixture of species is present. The dominant stand contains chestnut, northern red, scarlet, and black oaks, and black locust, yellow-poplar, sweet birch, and ash. Yellow-poplar and particularly sweet birch appear to have lost ground in the past few years. Chestnut oak is by far the most frequently occurring tree in the size group over 5 inches. An important species under 5 inches is mountain-laurel; it is not found on the lower slope, but the 162 stems per acre on the middle slope may have considerable impact on the future of this stand. Rhododendron is also present on this slope (31 stems per acre), but is not found on either the lower or upper slopes.

Lower Slope—The lower slope contains deeper soil with more available moisture. Site index here is 105 for yellow-poplar and about 80 for the oaks. The basal area totals 65 square feet per acre, with 44 square feet in trees 5 to 12 inches d.b.h. and 21 square feet in trees over 12 inches. The lower slope, with an average per-acre yield of 2,345 board feet, contains almost all the sawtimber trees plus 13 cords of smaller wood. Almost all the sawtimber and 3.5 of the cords are yellow-poplar.

The change in site index from upper to lower slope shows the effect of site on species composition. On the lower slope yellow-poplar dominates the overstory, with a few sweet birch and even fewer northern red oak codominant. On the basis of frequency, shrubs, miscellaneous trees, dogwood, and red maple are of considerable importance on this slope.

And The Future

The stand is now at a point where it could be manipulated toward several objectives. Though small for management, it has the biological potential for timber production, wildlife habitat, and esthetic achievement. Because of its proximity to a large creek it is also important for watershed values. Since all these objectives require a healthy, vigorous stand, a thinning will soon be needed. On the lower slope timber production could be a major objective, so thinning should favor yellow-poplar. On the middle slope wildlife habitat and timber production could be enhanced by giving the better oaks more room to grow. Esthetics should be given primary consideration on the upper slope because it is in view of the Blue Ridge Parkway. By careful thinning and removal of some of the overstory on the upper slope, the plethora of dogwood, azalea, mountain-laurel, and red maple could be formed into a mountain garden.

We have seen that a defective, rundown forest can be effectively regenerated through clearcutting and judicious thinning. This finding assumes major importance when we consider that past cutting practices have left many southern Appalachian forest stands defective and overmature. It is interesting to tie the development of this stand to the development of thought concerning silvicultural methods of harvest and regeneration of hardwoods in the Appalachians. When the study was installed, any land intensively managed was under the selection system. Gradually, observant foresters recognized the need for additional techniques and tried such methods as group selection and shelterwood cuts. Now, as this stand reaches early adulthood, there is widespread application of even-aged silviculture involving some form of clearcutting. It is obvious that results from the forest stand described in this report, plus many others like it, have played a considerable part in the development and technical acceptance of even-aged silviculture.

Successful regeneration, however, does not always result in a completely acceptable situation. The degree of acceptability depends on the object of management and where we choose to look on the slope. The timber grower may not be pleased with the response of the upper slope, while the wildlife manager may not be satisfied with the almost pure stand of yellow-poplar developing on the lower slope. Nevertheless, from almost any viewpoint, the stand today is better than the one removed by clearcutting in 1931.

Literature Cited

1. JEMISON, G. M. 1946. Rehabilitation of defective Appalachian hardwood stands. J. Forestry 44: 944-948.
2. WAHLENBERG, W. G. 1952. How to harvest. Effects of cutting methods in growing Appalachian hardwoods. South. Lumberman 185(2321): 175-178.