

INTENSIVE GROUP SELECTION SILVICULTURE IN CENTRAL HARDWOODS

AFTER 40 YEARS¹

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Abstract.--In 1947 conferences of Forest Service research people from Federal, Regional, and Research Center units met in Southern Illinois to set up in 1948 a whole rotation study on the Kaskaskia Experimental Forest involving 38 commercial compartments. The chief objectives were to evaluate the success, ability for sustained silviculture, and the costs and returns for a full sawtimber rotation for different silviculture systems. The uneven-aged systems included intensive-group selection silviculture as a major component. This paper is confined to regeneration and stand growth on uneven-aged compartments with combined treatments of group selection, improvement cutting, and killing of cull trees. Active commercial cutting continued for 20 years after which the study was terminated in 1968. Photographs were taken in 1988 of the stands undisturbed since 1968. The treatments were successful in terms of regeneration in openings, stand quality, stocking, and net growth while maintaining a continuous and diversified forest cover.

INTRODUCTION

In 1947 conferences of Forest Service people were held in Southern Illinois to decide on a research program for the Kaskaskia Experimental Forest located on the Shawnee National Forest. The conferees were composed of Washington high-level Forest Service research people and forest management research people from the Central States Forest Experiment Station and the Carbondale Research Center. An agreement was reached on the dominant study, hereinafter called the "Compartment Study" and a working plan was written and approved. This study was fully active for 20 years but terminated in 1968, about one-fourth of the work plan goal of one rotation. It is essential to note that

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numerous color slides were taken in March 1988 to show conditions at about half rotation in the absence of further cuttings or inventories since 1968.

OBJECTIVES

Objectives of these commercial-type compartments (average 20 acres) were concerned with long-term silvicultural systems and variations of systems for both short and long-term values and to sustain a natural and healthy forest ecosystem. These objectives for uneven-aged silviculture included logging methods, various silvicultural systems, long and short cutting cycles, long and shorter rotations and intensive and extensive management. Even-aged silviculture included stand conversion from hardwoods to short leaf pine, two-cut shelterwood, and commercial clearcutting for sawtimber (no culls killed). Costs in physical units were kept for all operations. Two general sites were sampled, coves and northerly slopes vs. ridgetops and south slopes. During the 20 years (1948 - 1968) 106 cutting operations on 755 acres removed about 2 million bd. ft. of sawlogs.

This paper will cover only the uneven-aged intensive group selection silvicultural management method with data up to 20 years and slides

taken 40 years after start of management in 1948. This includes 21 compartments, 13 on coves and northerly slopes and 8 on ridges and south slopes. Because of ecological characteristics and past cutting history most stands on the Kaskaskia were uneven-aged at the start of management, as shown by actual inventory data.

TREATMENTS

It is essential that the actual treatments as started in 1948 and continued thereafter be understood. At present it is common for foresters to use patch cutting and call it group selection. In this study the following classes of merchantable trees 11 inches d.b.h. and above were marked to cut over the whole management unit (compartment): financially mature but otherwise sound and desirable, high risk trees, and sound but low quality trees. Cull trees (unmerchantable now or in the future) were killed. All others, good growing stock, were left. Trees (poles) 5 to 10 inches d.b.h. which were potential good growing stock were left unless too dense. Others were killed. We had no markets for firewood or pulpwood. In this operation close attention was paid to find opportunities to create openings for new regeneration. As shown later, minimum size openings should be as wide as height of surrounding trees. Opening sizes will range up to one-half acre or even more on some poor areas. Openings are easy to create on previously unmanaged and often high graded forests. This is selection cutting based on tree and forest characteristics and not mechanical in nature. Financial maturity is based on some chosen percent value return and on site quality. Our mature trees ranged usually from 20 to 24 inches d.b.h. and good growing stock usually made up at least 50 percent of the basal area.

Control was by complete inventory giving volume and diameter distribution of the management unit as a whole. This could be done by sampling. Treatments were made in 5 to 6 year and 10 to 12 year cycles. Some compartments were cut three times. The ideal stand structure, volume, and tree quality was approached gradually and considerable flexibility was anticipated but the goal of a continuous forest was always maintained.

In intensive management time and money was spent to kill culls and do release and weeding as required. Thousands of cull trees were killed. Openings for regeneration were cleared of brushy competition if needed. For intensive management no culls were killed and no improvements made that involved costs. For example, the commercial clearcut compartments had a high residual of cull trees.

NATURE OF THE ORIGINAL FORESTS AND EARLY RESPONSE TO MANAGEMENT

Early in the compartment study a complete inventory had been made on 22 compartments totaling 420 acres of unmanaged stands (Minckler and Roach, 1955). About 18 percent of the pole trees and 10 percent of the sawtimber-sized trees were culls. The average sawtimber volume per acre of merchantable trees was 4020 bd. ft. (International 1/4-inch rule), and composition by tree classes and size is shown in Table 1.

Table 1.--Volume per acre of unmanaged forests on first 22 compartments treated; Kaskaskia Exp. Forest

Tree Class	Sawtimber 11-17 inches d.b.h.	Sawtimber 18 inches and larger	Totals
Growing-stock ¹	1625	460	2085
Mature and sound low quality	695	695	1335
Poor risk; over-mature and defective	245	355	600
Totals	2565	1455	4020

¹Number of trees per acre:
19 of 39 sawtimber trees were good growing stock; 46 of 94 pole trees were good growing stock.

The seven earliest cuts had a 600 bd. ft. per acre improvement cut and all culls killed. The average periodic annual net growth after cutting was 272 bd. ft. per acre (Minckler, 1955). Some of this was in-growth from the residual large poles (Minckler, 1957). Immediate and rapid increase in diameter growth of white oak occurred after release (Minckler, 1967) except for suppressed trees with poor crowns. Observation has shown that other species of oak poles still vigorous and with good crowns also responded to release.

Another early example of response to intensive management and group selection in two cuts (1952 and 1959) was the 21-acre "poor" and high graded woodland (Table 2). This shows dramatically how correct application of ecological knowledge can aid nature and increase productivity. The net growth even during the first 15 years was 128 bd. ft., culls had been reduced to zero, and there was a sharp ingrowth of saplings into pole sizes. Many openings were made and these were soon filled with mixed oaks,

Table 2. Intensive group selection silviculture on 21-acre poor farm woodland demonstration

	Intensive improvement and group selection cutting,		1967 Inventory
	Original stand 1952	1952, 1959	
Sawtimber volume; trees 11 inches d.b.h. and larger, bd. ft.	3048	1762	3190
Number of cull trees 5 inches d.b.h. and larger	67	67	0
Number of good growing stock trees 5-10 inches d.b.h.	36	0	59

hickory, yellow poplar and other miscellaneous timber species. By some standards this area would have been clearcut in 1952. The 1988 slides show a beautiful stand of poles and small sawtimber.

EARLY REGENERATION AND GROWTH RESPONSE TO INTENSIVE GROUP SELECTION SILVICULTURE

The earliest survey of reproduction in openings was made on 7 compartments of mixed hardwoods (coves and northerly slopes) and 3 compartments of oak hickory (ridges and south slopes) four years after treatment (Minckler and Jensen, 1959). Treatments removed 600 to 1200 bd. ft. per acre of sawtimber plus killing 36 cull trees per acre.

On the 10 areas surveyed there was about 3000 desirable, well-distributed seedlings and seedling sprouts per acre of openings on both sites. There was an additional 3000 of miscellaneous timber and nontimber species in small coves and about 1700 on oak-hickory sites. Yellow poplar reproduced poorly in thick litter and oaks and yellow poplar had more new reproduction and faster growth in the cut openings.

In 1971 with the cooperation and support of the National Parks and Conservation Association, Peter A. Twight, with the help of a forest technician, made a 100 percent inventory of two mixed hardwood compartments totaling 38 acres and with three cutting treatments between 1949 and 1971 (Twight and Minckler, 1972). I surveyed openings for regeneration by milacre plots.

The original stand in 1949 averaged 5579 bd. ft. per acre of merchantable trees 11 inches d.b.h. and above. In the three cuts 3579 bd. ft. were removed and the culls killed. In 1971 the merchantable sawtimber stand was 5763 bd. ft. per acre.

The stand data before and after management are shown in Table 3. The net production on this 38 acres for 22 years after the beginning of management was 171 bd. ft. per acre per year plus elimination of all cull trees, improved stand quality, and the establishment of new regeneration in openings. Note that volume of oaks and yellow poplar increased and that of hickory and miscellaneous species decreased.

The latest regeneration count was made on this area in 1971 in 34 openings on the 38 acres just discussed (Twight and Minckler, 1972). Openings were made by treatment procedures for group selection already discussed. The results show a diversity of species ranging in diameter (at 4.5

Table 3. Total numbers and board foot volume, 1949 and 1971, on 38 acres after 3 cuts totaling 136 M bd. ft. plus killing culls.¹

1949	Hickory	White Oak	Red Oaks	Yellow Poplar	Miscellaneous	Totals
Number of trees ² ₃	982	838	1,552	349	862	4,593
Board foot volume ³	40,090	26,340	89,220	40,000	17,020	211,670
Percent of trees	21	18	34	8	19	100
Percent volume	19	12	42	19	8	100
1971	Hickory	White Oak	Red Oaks	Yellow Poplar	Miscellaneous	Totals
Number of trees ² ₃	507	829	868	314	107	2,625
Board foot volume ³	22,192	33,687	114,725	42,240	3,280	219,124
Percent of trees	19	32	33	12	4	100
Percent volume	10	15	52	21	2	100

¹Taken from Twight and Minckler, 1972.

²Trees 5 inches d.b.h. and above.

³Trees 11 inches d.b.h. and above (International 1/4-inch rule).

ft.) from less than one inch to four inches (Table 4). The reproduction in these openings had not been weeded but all openings were cleared of overstory trees

REGENERATION RELATED TO OPENING SIZE

A regeneration study 10 years after cutting in 100 group selection openings on 10 compartments related regeneration to size of openings (Minckler and Woerheide, 1965). Desirable reproduction occurred on all sizes but composition and size of saplings 10 feet and taller was related to opening size and site (Table 5).

The larger opening sizes of 1½ to 2 generally had taller reproduction. Openings of less than ¾ to 1- size are too small for successful development of regeneration with the possible exception of white oak. The amount of light in group selection openings is highly correlated with opening size (Minckler, Leon, 1961).

Observations of old openings show that crowns of edge trees intermingle, and spacing between edges tends to become normal. Epicormic sprouting of leave edge trees did not occur except on trees with low crown ratios, generally not left as good growers.

SUMMARY

The one-fourth rotation active work before termination could not fulfill all the original objectives of the compartment study. But the 20 years of active research, plus the colored slides taken in 1988 at half rotation, gave substantial results on regeneration and stand growth from intensive group selection silviculture up to 40 years.

The treatment of intensive group selection and stand improvement cuts is described and

clarified. Regeneration in small cut openings of 1 to 2 sized or larger was successful in species, numbers, and growth. Patch cutting of larger openings is usually not required or appropriate. A continuous diversified forest is obtained which can gradually be brought to the desired uneven-aged stand structure by diameter distribution control of the management unit. The treated stands of good quality trees have a range of size from saplings (in new openings) to poles and saw-timber. Net volume growth during this management period was good. Stands at half-rotation (1988) are well-stocked and of high quality, as shown by photographs, as no further inventories have been taken since 1968 with one exception, 1971. New inventories of the 38 compartments at half rotation (about 1988 - 1990) would add vital information, and with the cost data already obtained, allow conclusions on the cost results if markets for pulpwood and firewood were now available.

Finally, on eastern mixed hardwood forests the choice is not always "rehabilitate or regenerate" but often rehabilitate and regenerate. This choice should also be based on owner's or public desires and needs. Foresters have flexible actions which are ecologically sound.

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Table 4. Reproduction numbers per acre in 1971 of trees not overtopped in 34 cut openings on the study area. Data after three cuts between 1949 and 1967.

Diameter at 4.5 ft.	Hickory	White Oak	Red Oaks	Yellow Poplar	Black Gum	Miscellaneous ¹		Dogwood	Timber	Species
						Timber	Non- Timber			
1 in.	47	34	28	91	41	97	110	28	339	476
1" - 2"	116	91	34	110	59	66	100	78	476	655
3" - 4"	50	116	6	69	22	22	3	16	285	304
Total	213	241	69	270	122	185	213	122	1100	1435
Percent	15	17	5	19	8	13	15	8	67	100

¹Miscellaneous species are sugar maple, white ash, black cherry, black walnut, sycamore, beech, and elm.

Table 5. Total amount of reproduction 10 feet and taller under canopy and in 100 openings of different sizes 10 years after cutting in 10 compartments

Coves and Northerly Slopes				
Species	Under canopy	Opening size ¹		
		1/4 and 1/2	3/4 and 1	1-1/2 and 2
----- Number per acre -----				
Yellow-poplar	0	60	330	290
White oak	120	180	200	360
Black and red oaks	50	50	70	65
Hickory	240	330	500	450
Miscellaneous desirable	15	30	180	50
Total desirable	425	650	1,280	1,215
Miscellaneous undesirable	100	130	450	630
Miscellaneous shrubs	360	600	1,240	950
Total undesirable	460	730	1,690	1,580
Southerly Slopes				
Yellow-poplar	0	0	0	0
White oak	140	120	235	400
Black and red oaks	10	15	120	130
Hickory	110	210	300	365
Miscellaneous desirable	0	0	0	0
Total desirable	260	355	655	895
Miscellaneous undesirable	25	55	80	100
Miscellaneous shrubs	50	110	340	300
Total undesirable	75	165	420	400

¹Diameter of opening related to height of surrounding trees. Thus, if width of opening is twice the surrounding tree height it is a 2-sized opening.

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