Thirty-eight Years of Group Selection in New England Northern Hardwoods

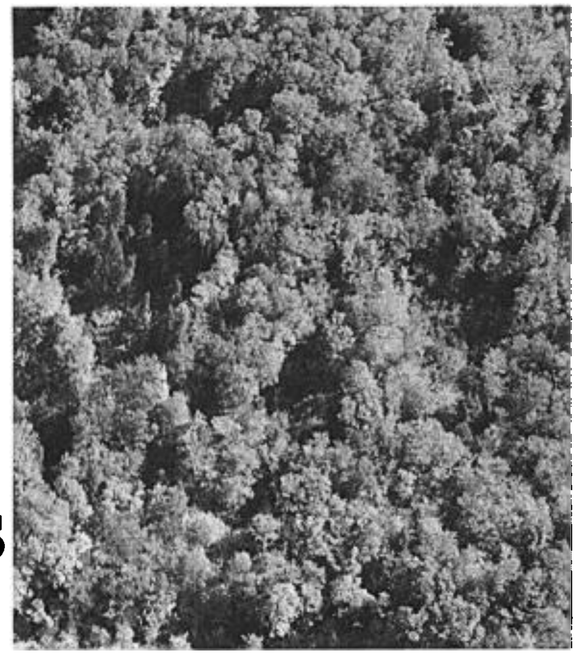

Figure 1. Group selection cuttings on the Bartlett Experimental Forest, New Hampshire.

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ABSTRACT—A 38-year period of group selection in northern hardwoods is resulting in a permanent composition of one-quarter to one-third intermediate and intolerant species. The diameter distribution follows the inverse J-shaped form that typifies uneven-aged stands. Uneven-aged management based on a combination of group and single-tree selection appears to be silviculturally sound.

One alternative in managing northern hardwood forests in New England is group selection, making openings of less than an acre. Two questions often are raised:

1. Although early regeneration is good (Jensen 1943, Leak and Wilson 1958, Filip 1969, Marquis 1965), will group selection really produce a permanently higher proportion of valuable intermediate and intolerant species than single-tree selection? Because small openings close in from the borders, will intermediate and intolerant species be crowded out over time?
2. Will group selection result in an irregular stand structure, leading to variable or unpredictable yields? Roach (1974) and Nelson et al. (1975) have raised this common objection.

Partly because complete answers to these and other questions are not available, the current reaction to group selection, used by itself or in combination with single-tree selection, is mixed. Some recommend it (Leak and Filip 1975, Minckler 1972, Watt et al. 1973). Some list it as a possibility (Tubbs 1973, Arbogast 1957, Eyre and Zillgitt 1953). And some generally oppose it (Roach 1974, Nelson et al. 1975).

Additional information about long-term effects on both species and structure are provided by a 38-year record from a tract on the Bartlett Experimental Forest, Bartlett, New Hampshire. This was a case history, without replication, and with some gaps in the record. But we believe that the long period of treatment and observation will help dispel some of the uncertainty about the use of group selection in hardwood forests, with particular reference to northern hardwoods in New England.

Areas and Methods

The tract consists of two adjacent compartments, numbers 5 and 6 on the Bartlett Forest, a total of about 114 acres. In 1937, when the first cuttings were made, these compartments contained typical old-growth northern hardwoods. The compartments had been high-graded about the turn of the century for the better softwoods and hardwoods. During the period 1931-1940, typical old-growth stands on the Bartlett Forest contained 105 to 120 square feet of basal area per acre in trees 5.0 inches in d.b.h. and larger, and 65 square feet in sawtimber. Species composition as a proportion of basal area was about 70 percent tolerants (beech, sugar maple, eastern hemlock, red spruce), 25 percent intermediates (yellow birch, red maple, and white ash) and 5 percent intolerants (paper birch primarily) (Filip et al. 1960).

Beginning in 1937, the tract was cut by group selection at intervals of 9 to 14 years (*table 1*). These groups ranged in size from about 0.2 acre to a little over 1 acre, and averaged 0.5. The cuttings were centered

Table 1. Cutting history on compartments 5 and 6 combined, 113.8 acres, Bartlett Experimental Forest.

Year	Groups	Total area	Average group size
	No.	*Acres*	*Acres*
1937-40	32	11.2	0.35
1951	39	18.0	.5
1960	13	9.1	.7
All	84	38.3	0.5

around clusters of old trees. In each group, all hardwoods down to about 2 inches in d.b.h., were cut (*figs. 1* and *2*); in New England, this approach is sometimes called small-patch cutting. Where a softwood understory was well developed, larger softwood saplings and small poles were left intentionally; when understory trees are retained, the cutting method is often referred to as group selection, to distinguish it from small-patch cutting.

At the beginning of the study, this type of group cutting was considered appropriate for even-aged management with area control, and so the acreages harvested during each operation were recorded. From this record, we estimated the implied rotation period for the tract. During the 38 years from the first cut in 1937 and to the time the fourth cut was due in 1975, 38.3 acres were cut, approximately 1 per year. At this rate, it would take about 114 years to work through the entire tract. Since recommended rotations for even-aged stands in northern hardwoods are 100 to 120 years, such a rate is reasonable.

Because we have since found it difficult to relocate old group cuttings, and time-consuming to determine acreages, we do not currently believe that area control is feasible for regulating this type of silviculture. However, the acreage measurements provide assurance that the tract was fairly well regulated by area control under a conventional rotation length. By examining current forest conditions, we should gain insight into the composition and structural characteristics of a tract that might be handled on a sustained yield basis by uneven-age management.

Cutting was not uniform throughout the tract. On one compartment, the acreage cut was about twice that on the other. In reporting results, however, we have combined both compartments because (1) the entire tract was handled as a single logging unit, (2) future cuts on a tract of this type would tend to even out differences in rates, and (3) questions about stand structure and composition are best answered by results from large acreages.

When the tract was inventoried, in 1975, seventy 10-factor prism points, systematically spaced, were used to estimate trees six inches (5.0 to 7.0) in d.b.h. and larger. An 0.01-acre fixed-radius plot at each point was used for the two- and four-inch classes.

Species Distribution

Past research on the Bartlett Forest over a 10- to 15-year remeasurement period has indicated that regeneration under single-tree selection will be predominantly tolerant species (92 percent). On individual group cuttings, intermediates and intolerants may comprise a third or more of the stems (Leak and Wilson 1958, Marquis 1965).

After 38 years of this program of group selection, yellow birch and other intermediates—plus a few intolerants—make up one-quarter to one-third of the trees in the d.b.h. classes from 4 to 12 inches (*table 2*).

Table 2. Numbers per acre of tolerant species, yellow birch, and other commercial species.

D.b.h. (inches)	Tolerants[1]	Yellow birch	Other[2]
	No.	*No.*	*No.*
2	246	37	10
4	106	24	9
6	39	9	10
8	23	3	5
10	14	4	3
12	13	3	2
14	8	<1	1
16	5	1	2
18	5	<1	1
20	3	<1	1
22	1	—	<1
24	1	—	<1

[1]*Beech, sugar maple, red spruce, hemlock.*
[2]*Red maple, paper birch, white ash.*

Trees larger than 10 or 12 inches represent initial tract conditions more than they do regeneration and recruitment. The excess numbers of tolerants in the

Figure 2. The cuttings averaged 0.5 acre in size.

two-inch class are mostly beech rootsuckers, which grow in dense thickets in certain areas but apparently have not dominated the larger size classes.

Group selection appears to bring about a lasting improvement in species composition as compared to single-tree selection, which produces mostly tolerant regeneration.

Stand Structure

In 1975, diameter distribution on the tract closely followed the inverse J-shaped curve that typifies uneven-aged stands (*fig. 3*). A *q*—i.e., the average quotient between number of trees in successively smaller d.b.h. classes—of 1.6 (least squares solution = 1.55) represents this diameter distribution quite well, though some departures are evident because of wavelike variations. We are beginning to realize, however, that constant or balanced structures may depart somewhat from the inverse J-shaped form in uneven-aged stands. Slightly S-shaped forms may characterize managed (Adams and Ek 1974) or unmanaged stands (Goff and West 1975). There is no evidence that a regular program of group selection will lead to a variable structure or extremely variable yields.

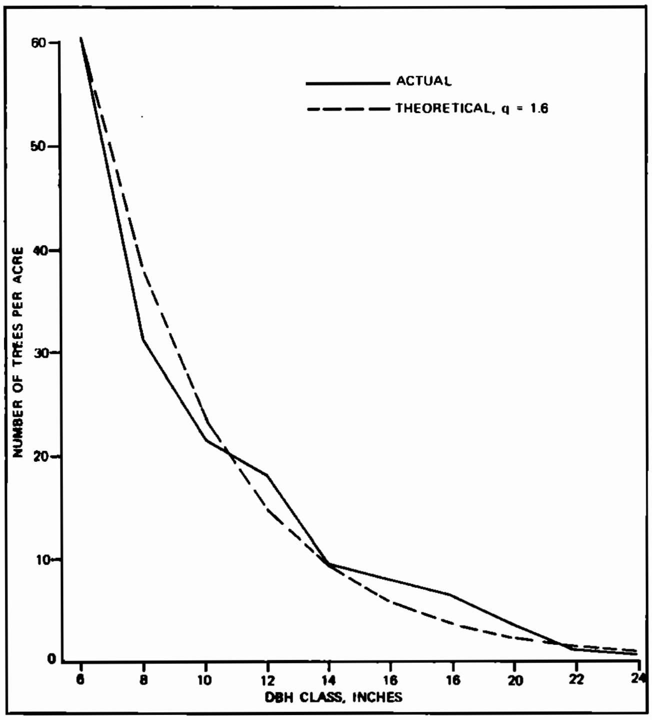

Figure 3. Diameter distribution in 1975, and a theoretical distribution based on q=1.6.

Basal area in 1975 on the entire tract was 95 square feet per acre in trees six inches d.b.h. and larger, and 60 square feet in sawtimber-size trees (*table 3*). These basal areas represent tract conditions before cutting on a 10- to 15-year cycle. Current recommendations for single-tree selection in New England northern hardwoods specify cutting when a stand has 100 square feet of basal area or more (Leak et al. 1969). Under group selection, basal area stocking before cutting apparently is about the same—slightly lower, perhaps—than under single-tree selection.

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Table 3. Basal area per acre on the entire tract in 1975, by d.b.h. group.

D.b.h. (inches)	Basal area
	Sq. ft.
6-10	35
12-16	35
18-24	25
All	95

Discussion

Since group selection improves species composition, and maintains stocking and structural conditions similar to those advocated for single-tree selection, it seems feasible to use a combination of group and single-tree selection as one alternative for managing northern hardwoods in New England. Group selection should be used to remove groups of mature and overmature trees, and to maintain a mix of intermediate and some intolerant species. Saplings and small poles can either be left or taken, depending upon their species and quality.

Single-tree selection can be applied between groups to remove some risky, overmature, or mature trees, and to shape stand structure as desired. We believe that any combination of these methods can be used to reduce the stand to an acceptable residual stocking for northern hardwoods in New England: about 65 to 80 square feet of basal area per acre in trees six inches in d.b.h. and larger with at least 30 to 35 square feet of basal area in good sawtimber-size trees. ■

Literature Cited

ADAMS, D. M., and A. R. EK. 1974. Optimizing the management of uneven-aged forest stands. Can. J. For. Res. 4:274-287.

ARBOGAST, C. 1957. Marking guides for northern hardwoods under the selection system. USDA For. Serv. Lake States For. Exp. Stn. Pap. 56. 20 p. St. Paul, Minn.

EYRE, F. H., and W. M. ZILLGITT. 1953. Partial cuttings in northern hardwoods of the Lake States: Twenty-year experimental results. USDA Agric. Tech. Bull. 1976. 124 p. Washington, D.C.

FILIP, S. M. 1969. Natural birch regeneration in New England. P. 50-54 *in* Proc. Birch Symp. USDA For. Serv. Northeast. For. Exp. Stn., Upper Darby, Pa.

FILIP, S. M., D. A. MARQUIS, and W. B. LEAK. 1960. Development of old-growth northern hardwoods on Bartlett Experimental Forest: A 22-year record. USDA For. Serv. Northeast. For. Exp. Stn. Pap. 135. 7 p. Upper Darby, Pa.

GOFF, F. G., and D. WEST. 1975. Canopy-understory interaction effects on forest population structure. For. Sci. 21:98-108.

JENSEN, V.S. 1943. Suggestions for the management of northern hardwood stands in the Northeast. J. For. 41:180-185.

LEAK W. B., and S. M. FILIP. 1975. Uneven-aged management of northern hardwoods in New England. USDA For. Serv. Res. Pap. NE-332. 15 p. Northeast. For. Exp. Stn., Upper Darby, Pa.

LEAK, W. B., and R. W. WILSON, JR. 1958. Regeneration after cutting of old-growth northern hardwoods in New Hampshire. USDA For. Serv. Northeast. For. Exp. Stn. Pap. 103. 8 p. Upper Darby, Pa.

LEAK, W. B., D. S. SOLOMON, and S. M. FILIP. 1969. A silvicultural guide for northern hardwoods in the Northeast. USDA For. Serv. Res. Pap. NE-143. 34 p. Northeast. For. Exp. Stn., Upper Darby, Pa.

MARQUIS, D. A. 1965. Regeneration of birch and associated hardwoods after patch cutting. USDA For. Serv. Res. Pap. NE-32. 13 p. Northeast For. Exp. Stn., Upper Darby, Pa.

MINCKLER, L. S. 1972. Hardwood silviculture for modern needs. J. For. 70:10-17.

NELSON, J. C., B. A. ROACH, O. L. FRANK, and W. W. WARD. 1975. Timber management. P. 33-49 *in* Clearcutting in Pennsylvania. Pa. State Univ. School For. Resour. Col. Agric., University Park.

ROACH, B. A. 1974. Selection cutting and group selection. AFRI Misc. Rep. No. 5. 9 p. SUNY Coll. Environ. Sci. For., Syracuse, N.Y.

TUBBS, C. H., and R. M. GODMAN. 1973. Lake States northern hardwoods. P. 55-58 *in* Silvicultural Systems for the Major Forest Types of the United States. USDA For. Serv. Agric. Handb. 445. Washington, D.C.

WATT, R. F., K. A. BRINKMAN, and B. A. ROACH. 1973. Oak-hickory. P. 66-68 *in* Silvicultural Systems for the Major Forest Types of the United States. USDA For. Serv. Agric. Handb. 445. Washington, D.C.