Proceedings of the SYMPOSIUM ON INTENSIVE CULTURE OF NORTHERN FOREST TYPES

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FOREWORD

THE NORTHERN FOREST TYPES constitute a vast natural resource for the United States and Canada. For instance, in the eastern United States there are more than 10 million acres of commercial forest land supporting spruce and fir types alone. The magnitude and variety of this resource is such that treating it in any detail at a 3-day meeting was impossible. Rather, the idea that germinated and developed into this symposium was to present a broad picture of the extent of our knowledge of intensive cultural techniques, the status and trends of our research in the northern forest types, and some actual experiences in managing this resource; and to explore those factors that affect our use of the intensive cultural techniques we have at hand.

There is no doubt that we face a new era in the management of northern forests. The production of wood products is no longer the primary objective of many owners, and increased pressure for the social values of our forests is being felt by all landowners. We must recognize these other forest values, which in turn dictates intensification of all aspects of forest management if we are to meet the future demands of a wood-hungry society.

The enthusiastic efforts of the symposium sponsors—the School of Forest Resources, University of Maine; the Maine Bureau of Forestry; the Maine Forest Products Council; and the U.S.D.A. Forest Service—and the individuals behind those efforts, should be commended. Special thanks are due to Great Northern Nekoosa, Inc., and Brooks B. Mills for their help in providing interesting field trips, and to the Casco Bank and Trust Co. for sponsoring the symposium brochure. Also, without the enthusiastic participation of the experts invited to present papers, and the moderators of each session, the Symposium could not have taken place.

—**BARTON M. BLUM**
Symposium Chairman

PUBLISHER'S NOTE

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held 20-22 July 1976 at Nutting Hall, University of Maine, at Orono.

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C. D. Hartley, Valley Forest Products Ltd., Canada: 22 July 1976, morning session.

CONTENTS

HOW APPLICABLE IS UNEVEN-AGE MANAGEMENT IN NORTHERN FOREST TYPES?

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Abstract

For the proper application and practice of uneven-age management, one must consider residual stocking, maximum tree-size objective, and diameter distribution. All three components are described, and it is shown how they fit into a practical package for application in a timber tract.

THE DECISION to practice uneven-age management in northern forest types is usually based on a combination of factors. Although some of the factors are concerned with silvical or ecological requirements of the species or species groups being managed, there often are other overriding considerations.

But first, what is uneven-age management? What are some of the major components of the system?

There are several definitions and descriptions in forestry literature, and I am sure each of us has our own pet way of describing uneven-age management.

An all-inclusive definition of uneven-age management was presented recently at a workshop sponsored by the U.S. Forest Service (1975). I believe it is a good one. Essentially, uneven-age management is the manipulation of a forest for continuous tall-tree cover and the orderly growth and development of desirable trees, through a range of diameter classes, to provide sustained even-flow yields.

It is implemented through the selection system: single-tree selection for mostly tolerant species, or a combination of single-tree and group selection to increase the proportion of intermediate and intolerant species (Berry 1963; Leak and Filip 1975; Roach 1974). Each operation is not only a harvest of merchantable products, but also an improvement cutting and release job to promote the growth of the retained trees and to maintain or enhance stand structure and composition. Managed uneven-age forests are composed of intermingled trees or groups of trees that differ markedly in age (U. S. Forest Service 1973), but no separate age classes are recognized in regulating the yield (Meyer and others 1962).

For the proper application and practice of uneven-age management, at least three basic components must be taken into consideration: residual stocking, maximum-tree-size objective, and diameter distribution based on a q-factor guideline.

The real challenge to foresters is to understand how all three are linked together, and how they affect growth and quality, allowable harvest, operating cycle, timber-stand-improvement requirements, and the entire economic situation.

RESIDUAL STOCKING

Residual stocking is the volume or basal area to be retained after each cyclic harvest for further growth and development. Available data show that total stand growth varies only slightly over a moderately wide range of stocking levels. Cutting mature stands back to about 50 or 60 percent of full stocking is generally adequate for the northern forest types (Frank and Bjorkbom 1973; Leak and Filip 1975; Tubbs 1968). For example, a residual stocking of about 70 to 80 square feet per acre in trees 6 inches dbh and larger is recommended for northern hardwoods in New England.

MAXIMUM TREE SIZE

The largest tree to be retained after each timber harvest under uneven-age management in northern forest types ranges between 16 and 24 inches dbh. Much depends on site quality, the growth capability of the species involved, the accepted rate of return, and the owner's objectives for the tract.

DIAMETER DISTRIBUTION

The third component that is important in uneven-age management is diameter distribution; that is, retaining an adequate number of trees per acre after each harvesting operation. A prescribed residual diameter distribution, of course, determines the residual basal area and volume.

The general procedure for establishing a diameter distribution is to apply a q-factor guideline, usually referred to as q. The q simply refers to the average quotient or ratio between numbers of trees in successively smaller diameter classes. An ideal structure based on the same q-factor throughout all diameter classes is represented graphically by a smooth reverse-J-shaped curve. Q-factors ranging from 1.3 to 1.7 for 2-inch dbh classes have been recommended as goals in uneven-age management (fig. 1). The lower the q, the higher the number and proportion of large trees in the stand. Old-growth stands tend to have a lower q than second-growth stands.

PUTTING IT ALL TOGETHER

Now that we know something about the three essential components characterizing uneven-age management, how do we link them together into a practical package? And, probably of greater interest and concern to you: How is this package applied on the ground?

Many timber managers undoubtedly have been and still are reluctant to accept all this formality behind uneven-age management. They probably have good reasons for this, and I believe the major one is the apparent difficulty in trying to mark the timber tract to a rigid residual diameter distribution. I admit that trying to control the marking to some specified numbers of trees per acre (or basal area) by 2-inch dbh classes is not easy. Actually, it would be impractical, if not impossible, to maintain the perfect diameter distribution indicated by a smooth reverse-J-shaped curve. Really, it is not necessary to be that exact. The structure represented by the curve is only a guide. But you should not stray too far from it so as to be assured an even-flow of products, especially the large-size sawtimber.

Undoubtedly, most of the stands in northern forest types have an imbalanced diameter distribution; that is, there are excesses in some diameter classes and deficiencies in others--although graphically resembling the typical reverse-J-shaped form. Also, the average q is probably somewhere between 1.7 and 2.0--somewhat high--and merchantable trees larger than 20 inches dbh are not too prevalent.

Many uneven-age management recommendations suggest diameter distribution or stocking goals based on a

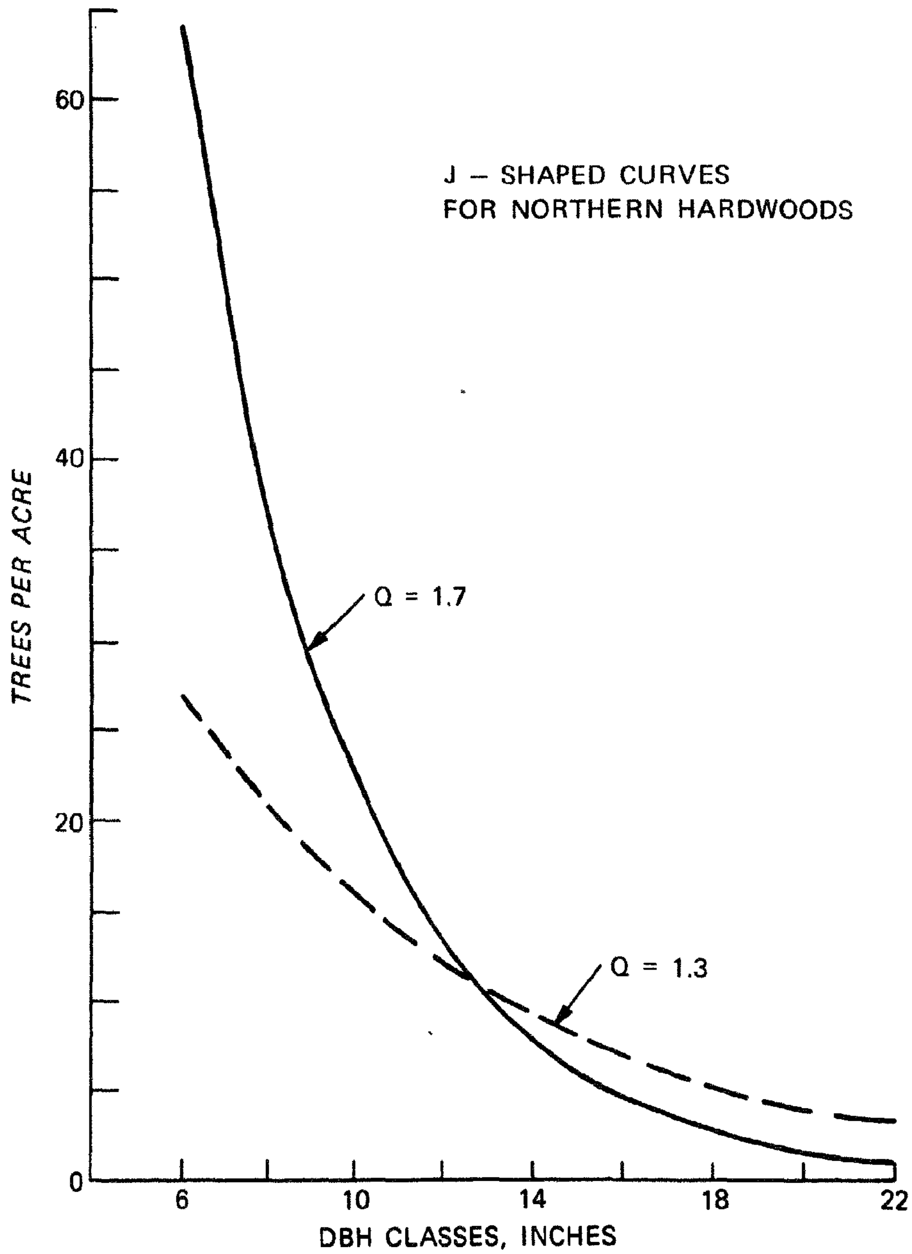

Figure 1.--J-shaped curves for northern hardwoods.

a constant q ratio of 1.3. This probably is too low for most stands, if the major objective is timber production. A q of 1.5 or a little higher would be a more realistic long-term goal. Some stands may require several improvement or conditioning operations before the long-term goal is achieved. In the improvement or conditioning operations, it may be more economical to regulate initial yields by a set of components that blend more closely with existing stand conditions.

For example, for second-growth northern hardwoods in New England, which usually have a high q, we recommend an initial structural guide based on a q of 1.7 or 1.8, about 70 square feet per acre, and a maximum diameter class of 18 or 20 inches (Leak and Filip 1975). If we attempted to use a management package based on a q of 1.3 or 1.4 and 80 square feet per acre, and a 22- or 24-inch maximum tree size as an immediate goal, we would run into application problems. Trees in the large sizes would be lacking, and a heavy treatment in the small sizes would be required--which may not be economically justified. However, these latter components could probably be applied immediately in many old-growth northern hardwood stands.

After a timber cruise is made, q can be calculated for the stand by using the least-squares method proposed by Leak (1963). Armed with the information on q, as well as the desired stocking goal and maximum tree size, a forester can readily compute a stand-structure guide for the tract (table 1). From this computed information, an allowable harvest by diameter classes can be determined.

A more practical procedure, especially in small woodlands, is to use a diagnostic tally sheet containing a stand-structure guide based on a predetermined value of q (table 2). After the timber cruise is made, a forester can visually compare the structure of the stand with structures based on different q values; then he can select the one that compares most favorably. The next step is to prepare a prescription for treating the stand.

When marking the timber, it is often more practical--especially on large units of 100 acres or more--to guide the allowable harvest tally by grouping the trees in broader diameter classes than 2 inches. Three or four diameter groups can be used in the field if necessary, corresponding to poletimber--6, 8, and 10 inches; small sawtimber--12 and 14 inches; medium saw-

Table 1.--Calculation of a stand-structure guide for uneven-age management

1. List the dbh classes to be used. As a trial run, start with one tree in the largest diameter class. Keep multiplying by the selected q to get the number of trees in each smaller diameter class.

2. Calculate the basal area of each dbh class and determine the total basal area.[1/] This total basal area will not agree with the desired residual basal area stocking. Therefore, determine the ratio between the desired residual basal area and the calculated basal area.[2/] Multiply this ratio or correction factor by the numbers of trees and basal area in each diameter class. This correction gives the desired stand-structure guide.

Dbh class	Trial run (q = 1.7)		Desired structure (q = 1.7)	
	Trees per acre	BA per acre	Trees per acre	BA per acre
	No.	Sq. ft.	No.	Sq. ft.
6	40.8	8.0	63.5	12.5
8	24.0	8.4	37.3	13.1
10	14.1	7.7	21.9	12.0
12	8.3	6.5	12.9	10.0
14	4.9	5.2	7.6	8.1
16	2.9	4.0	4.5	6.2
18	1.7	3.0	2.6	4.7
20	1.0	2.2	1.6	3.4
Total	97.7	45.0	151.9	70.0

1/BA per dbh class = $0.00545D^2$.

2/Ratio or correction factor = $\frac{70}{45}$ = 1.556.

TABLE 2.--DIAGNOSTIC TALLY SHEET FOR UNEVEN-AGE MANAGEMENT

Cumulative Tally - Number of Trees Per Acre (B.A. Factor 10)

DBH	Number of Trees														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
6	51	102	153	204	255	306	357	407	458	509	560	611	662	713	764
8	29	57	86	115	143	172	201	229	258	287	315	344	372	401	430
10	18	37	55	73	92	110	128	147	165	183	202	220	233	257	275
12	13	25	38	51	64	76	89	102	115	127	140	153	165	173	191
14	9	19	28	37	47	56	65	75	84	94	103	112			
16	7	14	21	29	36	43	50	57	64	72	79	86	Basal Area		
18	6	11	17	23	28	34	40	45	51	57	62	6	Per Acre (sq.ft.)		
20	5	9	14	18	23	27	32	37	41				Merchantable		
22	4	8	11	15	19	23	27	30	34						
24	3	6	10	13	16	19	22	25	29	Tally	#Prism				
26	3	5	8	11	14	16	19	22	24	Legend	Points		Cull		
28	2	5	7	9	12	14	16	19	21	/					
30	2	4	6	8	10	12	14	16	18	O					
Total										X	Total B.A. ______ sq.ft.				
											Total #trees ______				

Total Number of Trees Per Acre - Add the last figure used in each block and divide by the number of point samples tallied.

B.A. per acre - Add the total number of entries by class (first row), multiply by 10, and divide by the number of point samples tallied.

STAND DIAGNOSIS

DBH Class	Present Stand		Q = 1.7		Surplus	(Deficit)	Marking	
	Trees per acre	Basal Area per acre	Goal per acre		Trees per acre	Basal Area per acre	per acre	
			Trees	Basal Area			Trees	B. A.
	No.	Sq. ft.	No.	Sq. ft.	No.	Sq. ft.	No.	Sq.ft.
6			63	13				
8			37	13				
10			22	12				
	Sub-total		122	38				
12			13	10				
14			8	8				
	Sub-total		21	18				
16			5	6				
18			3	5				
	Sub-total		8	11				
20+			1	3				
	Sub-total		1	3				
Total			152	70				

(Tally sheet suggested by Ken Lancaster), USDA, Forest Service) timber--16 and 18 inches; and large sawtimber--20 inches plus.

DISCUSSION

I believe a general misunderstanding of how uneven-age management works has caused much reluctance by many foresters and timberland owners to accept the system or to apply it completely. You either cut too much, or not enough, or the wrong trees; that has been the usual response. But as I described the details of the system to you, it can be made to work with flexibility to fit many stand conditions. Also, we now have tree-value conversion standards for several hardwood species, even to the point of making on-the-ground projections of each tree's development, based on each tree's own unique characteristics (DeBald and Mendel 1976; Mendel and others 1976).

Some foresters believe that it is difficult to harvest marked timber, as required by the system over a range of diameter classes, without injuring or damaging much of the residual growing stock. This is true to a degree. Regardless of whether track-type or wheeled skidders are used, some tree injury will occur. The injury need not necessarily exceed acceptable limits for timber production.

In a logging-damage study in northern hardwoods in New York State, logging injured about 30 percent of the residual trees; and major injury was done to about 20 percent (Nyland and Gabriel 1971). In our uneven-age management studies at the Bartlett Experimental Forest, logging injuries have been within these percentage ranges or usually lower. Of course, if felling and skidding operations are not planned properly, injury could be much higher, which would have a serious impact upon future tree quality. We must remember that logging injury can also occur in timber tracts under even-age management, particularly during commercial thinnings. Some care must be exercised under both systems.

Others say that uneven-age management can be applied only on small timberland ownerships--up to 200 or 300 acres. However, there are many portions of larger ownerships where uneven-age management would also be applicable. Areas with fragile soils, or with steep topography, or those areas that have high esthetic appeal, should probably be under uneven-age management. There are other areas covered by northern forest types that should also be considered for uneven-age management, especially where public use is increasing or multiple-use management is important. Where such areas must be partially cut to maintain high-forest conditions, they could be managed for sustained yield under uneven-age management, using the three basic components for stand manipulation that I have outlined.

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