# 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

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PUBLISHER'S NOTE

This report is published by the Northeastern Forest Experiment Station as a public service. The papers it contains are published as received from the authors. Any questions or comments about these papers should be directed to the authors.

# Proceedings of the SYMPOSIUM ON INTENSIVE CULTURE OF NORTHERN FOREST TYPES

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

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# HOW APPLICABLE IS EVEN-AGED SILVICULTURE IN THE NORTHEAST?

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## Abstract

The applicability of even-aged silviculture in the management of forest stands in the Northeast is examined through consideration of the forest stand, stand development, intermediate cuttings, and regeneration methods. It is concluded that even-aged silviculture is quite applicable in the management of forest stands in the Northeast.

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Experience has taught me that rational discussions of silvicultural practices require mutual understanding of standard terminology. I have had on occasion the frustrating experience of continuing a somewhat heated discussion regarding a particular silvicultural practice with a colleague only to realize eventually that we were in complete agreement but were using different terminologies. To avoid such an occurrence here, I shall give particular attention when warranted to terminology in answering the question, "How applicable is even-aged silviculture, i.e. the growing of timber crops in even-aged stands, in the Northeast?" Furthermore I have organized my answer in what seems to me to be a logical approach by considering the forest stand, stand development, intermediate cuttings, and regeneration methods.

## FOREST STAND

The forest stand is defined as being "a community of trees possessing sufficient uniformity as regards composition, constitution, age, spatial arrangement and/or condition to be distinguishable from adjacent communities so forming a silvicultural or management entity" (Society of American Foresters 1971). I should like to emphasize (1) that a forest is composed of forest stands, each occupying a specific area on the

landscape and reflecting the sum total of the time period and environmental conditions under which it has developed, (2) that forest stands, having developed under different time periods and/or environments, differ recognizably one from the other in one or more attributes and (3) that forest stands, because they differ one from the other, may require different silvicultural treatments to attain given objectives of management and therefore, form the basic units of silviculture. Professional foresters examine forest tracts, write silvicultural prescriptions, and impose silvicultural treatments stand by stand.

Forest stands are classified depending on their constitution, i.e. the representation and distribution of age and/or size classes, as being either even-aged or uneven-aged. Even-aged stands are composed of trees having no or relatively small differences in age. By convention, the maximum age differences admissible is generally 10 to 20 years, however, with rotations of greater than 100 years, differences up to 30 percent of the rotation may be admissible. Uneven-aged stands are composed of intermingling trees that differ in age more than is admissible for the stand to be classified as an even aged-stand.

Forest stands that originate following the destruction and/or removal of forest vegetation, whether by natural causes or man's activities, usually do so quite rapidly and are almost always even-aged. Forest fires, hurricanes, floods, insect and disease epidemics, timber harvesting, and the abandonment of crop and pasture lands have provided and continue to provide excellent opportunities for even-aged stands to become established. As pointed out by Smith (1972), foresters have repeatedly found the establishment of even-aged stands following major catastrophes to be a most common phenomenon.

Forest stands are also classified on the basis of composition, i.e. the representation of species in a stand expressed quantitatively as percent by number, basal area, or volume. Stands in which 80 percent of the trees forming the main crown canopy are of a single species are classified as pure stands. Stands failing to qualify as pure stands are classified as mixed stands. Pure stands are less common than mixed stands because sites favorable for the natural establishment and growth of only one tree species occur infrequently in nature (Baker 1950).

Since no two species have exactly the same pattern of height growth with respect to time, the main crown canopies of many even-aged mixed stands tend to become stratified vertically into more or less distinct layers (Smith 1972). In such stands, the crowns of the faster growing, more intolerant species occupy the uppermost layer of the crown canopy; the crowns of the slower growing, most tolerant species, the lowermost layer; and the crowns of species intermediate in growth and tolerance, if present, the middle layer. Stands of this type may appear to be uneven-aged but upon close examination are usually found to be even-aged. Mixed even-aged stands growing on good sites are usually quite productive and may provide the forest practitioner with a variety of management options, however, they are probably managed most effectively as even-aged stands.

## STAND DEVELOPMENT

Nondormant viable seed of all tree species germinate and produce established seedlings only on well-aerated, moist seedbeds under favorable temperatures and sufficient light. Consequently, natural seedbeds tend to be either very favorable or very unfavorable for germination and seedling establishment. Unfavorable seedbeds fail to become stocked with even a single seedling while favorable seedbeds become stocked with an excessive number of seedlings. Thus, even-aged stands and small even-aged groups of trees in uneven-aged stands begin life too densely stocked for individual seedling to grow for long entirely free of competition.

As a young stand begins to attain full occupancy of the site competition among trees for water, light, and nutrients intensifies both above and below ground, branches near the ground begin to die, and the trees begin to differentiate into crown classes in accordance with their relative ability to grow in height. The stronger, most vigorous individuals forge upward to occupy dominant and codominant positions in the crown canopy. The weaker, less vigorous individuals fall behind to occupy initially intermediate and later overtopped positions in the crown canopy where they are destined eventually to die. As the stand grows into the pole stage, competition becomes increasingly more intense, crown classes become more distinct, losses of trees due to suppression and death reaches a maximum, and natural pruning produces progressively longer branch-free boles and shorter crown lengths. By the time the stand has attained its maximum height for the site, competition has reduced

the crown size of most trees below that required for them to remain vigorous and the stand begins a long period of slow growth followed by a period of deterioration. Thinnings begun early in the life of the stand and repeated as needed would have increased the yield of merchantable wood, maintained the vigor of the crop trees, and lengthened the productive life of the stand.

## INTERMEDIATE CUTTINGS

An intermediate cutting is any cutting made in a forest stand between the time of its formation and the first regeneration cutting. Intermediate cuttings are conducted in immature forest stands with the two principal objectives of (1) enhancing the value of existing stands by controlling the composition, density, and growth through all stages of stand development and (2) increasing the total yield of stands by utilizing all of the merchantable wood produced during the life of the stand. Intermediate cuttings differ from regeneration cuttings in that no effort is made to secure regeneration and the creation of permanent openings in the crown canopy is carefully avoided.

Eight different kinds of intermediate cuttings, each designed to accomplish a particular purpose, are recognized as follows: (1) weeding (2) cleaning (3) liberation cuttings (4) thinning (5) improvement cutting (6) salvage cuttings (7) sanitation cutting and (8) pruning (Smith 1962). Weedings, cleanings, and liberation cuttings are conducted in stands not past the sapling stage of development to release desirable growing stock from the competition of herbaceous and woody vegetation. Improvement cuttings are made to improve the composition and quality of mixed stands past the sapling stage of development by removing trees of undesirable species, form and quality from the main canopy. Thinnings, made primarily to control the density and growth of stands, are conducted periodically as needed throughout all stages of stand development. Salvage cuttings to utilize merchantable wood in trees killed or injured by injurious agencies and sanitation cuttings to prevent the spread of insects or diseases are conducted as required throughout the life of the stand. Selected crop trees of species that produce lumber commanding a premium when free of knots may pruned to improve the quality and value of wood produced.

The judicious application of intermediate cuttings provides the best means of increasing the yield and quality of merchantable wood produced by a forest stand. Intermediate cuttings are as applicable in the management of uneven-aged stands as they are in the management of even-aged stands. However, the need for an intermediate cutting is more easily recognized and intermediate cuttings are more economically applied in even-aged stands than in uneven-aged stands.

## REGENERATION METHODS

A regeneration method is the procedure by which a mature forest stand is harvested and replaced with a young stand. A regeneration method includes not only the removal of the mature stand in such manner as to create, in so far as it is feasible, environmental conditions conducive to germination and seedling establishment but also any cultural treatments of the seedbed that might be required to ensure rapid replacement of the old stand by an adequately-stocked young stand of desirable tree species. Various methods of establishing even-aged forest stands from seed have found application, however, any given method can usually be classified under one of three standard regeneration methods each of which denotes distinctly different principles (Smith 1962). The three standard regeneration methods of establishing even-aged forest stands from seed are the clearcutting method, seed-tree method, and shelterwood method as defined below.

### Clearcutting Method

In the clearcutting method, all trees on an area to be regenerated are removed in one cutting with regeneration of desirable tree species being subsequently obtained either naturally from seed disseminated over the cutting area from adjacent forest stands and/or from trees removed in the harvesting operation or artificially by either planting tree seedlings or sowing seed on the cutting area.

Natural regeneration of a clear-cut area is usually either wholly or impart dependent upon seed disseminated naturally by wind subsequent to the removal of the mature timber, therefore, no portion of the clearcut area should be more distant from seed-bearing trees of the species to be regenerated than the distance to which the seed can be disseminated in sufficient quantities to produce adequately-stocked stands.

## Seed-Tree Method

In the seed-tree method, all trees on an area to be regenerated are removed in one cutting save for a small number of seed-bearing trees, usually from one to ten trees per acre, retained either singly or in small groups to provide seed for the subsequent natural regeneration of the area. Following the establishment of adequate regeneration, the seed-bearing trees may be removed in a second cutting or left indefinitely. Since under the seed-tree method of regeneration, a seed source is retained on the cutting area, the size of the cutting area is not limited as it is under the clearcutting method.

## Shelterwood Method

The shelterwood method involves the removal of all trees from the area to be regenerated in a series of cuttings extending over a period of years equal usually to no more than one-quarter and often not more than one-tenth of the rotation with the establishment of natural regeneration of desirable tree species being obtained under the partial shelter of the parent stand. Regeneration of a previously untreated mature stand by the shelterwood method may require three different kinds of cuttings namely, preparatory cuttings, seed cutting, and removal cuttings as defined below.

Preparatory cuttings. Preparatory cuttings are cuttings made to prepare dense mature forest stands, under which regeneration of desirable tree species has failed to become established for regeneration by (1) removing defective trees and trees of undesirable species (2) improving the vigor, seed production, and wind firmness of desirable tree species and (3) increasing the rate of decomposition of thick humus layers that tend to preclude the establishment of natural regeneration.

Seed cutting. The seed cutting is a cutting made in a mature forest stand to create permanent openings of sufficient size in the crown canopy to permit heat, light, and moisture to penetrate to the forest floor in amounts required for germination and seedling establishment of desirable tree species. To be most effective the seed cutting should be made during a year when the desirable tree species bear seed in abundance.

Removal cuttings. Removal cuttings are cuttings made to remove the remainder of the mature stand. Removal cuttings are commenced as soon as regeneration

has become established over a sizable portion of the cutting area and are continued periodically as required to prevent the mature stand from unduly retarding the growth of established regeneration. The last removal cutting (final cutting) is made when all portions of the cutting area have been regenerated satisfactorily.

Regeneration of an under-stocked mature stand under which an abundance of advance regeneration of desirable species has become established may require only one removal cutting to complete the regeneration process. Such a cutting may be classified erroneously as a clearcutting but, in as much as the regeneration has become established under the protection of an overstory, is properly classified as being the final removal cutting of the shelterwood method.

The three methods of regenerating even-aged forest stands differ one from the other in respect to the number of cuttings required to harvest the mature stand and the arrangement of the cuttings on the ground. The arrangement of the cuttings on the ground determines not only the quantity of seed available for dissemination over the cutting area but also the environmental conditions under which seeds germinate and seedlings become established. Thus, the applicability of a particular regeneration method is determined largely by the silvical characteristics of the species to be regenerated. Tree species intolerant of shade can usually be regenerated most effectively by either the clearcutting method or the seed-tree method. Tolerant tree species can usually be regenerated most effectively by the shelterwood method.

Application in the Northeast

The northeastern spruce-fir, northeastern northern hardwood, eastern white pine, Allegheny hardwood, and Appalachian mixed hardwood types occupying an estimated 11, 15, 7, 12 million acres and a substantial but undetermined acreage respectively in the Northeast have persisted through 200 years of exploitation (U.S. Department of Agriculture, 1973). Although other factors have undoubtedly played a significant role, the persistence of these forest types, in spite of the many and various types of treatment to which they have been subjected, can, I believe, be attributed primarly to the relative shade tolerance of the component species. Furthermore, I believe the regenerative response of the forest types over time and the results of research to date indicate strongly that they can be regnerated in even-aged stands by the

shelterwood method or some modification of this method as effectively as they can by any other natural regeneration method (U.S. Department of Agriculture, 1973)

## SUMMARY

In summary, I would emphasize the following:

1. Acceptance of the forest stand as being the basic unit of silviculture and dutiful observance of stand boundaries place a definite limitation upon the size of the area available for particular silvicultural treatment at any given time.

2. The forest stands with which foresters have to deal tend usually to be more even-aged than uneven-aged in constitution and more mixed than pure in composition.

3. Consideration of the way even-aged stands develop accentuates the need for intermediate cuttings applied periodically to favor the growth of crop trees and to utilize all merchantable wood produced by the stand.

4. The need for intermediate cuttings are more easily recognized and intermediate cuttings can usually be conducted more economically in even-aged stands than in uneven-aged stands.

5. When properly applied the clearcutting, seed tree and shelterwood methods of regeneration produce even-aged forest stands. Intolerant tree species are regenerated most effectively by either the clearcutting method or the seed-tree method and tolerant tree species, by the shelterwood method.

6. The major forest types in the Northeast can probably be regenerated by the shelterwood method or some modification of this method as effectively as they can by any other natural regeneration method.

7. Even-aged silviculture is quite applicable in the management of forest stands in the Northeast.

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