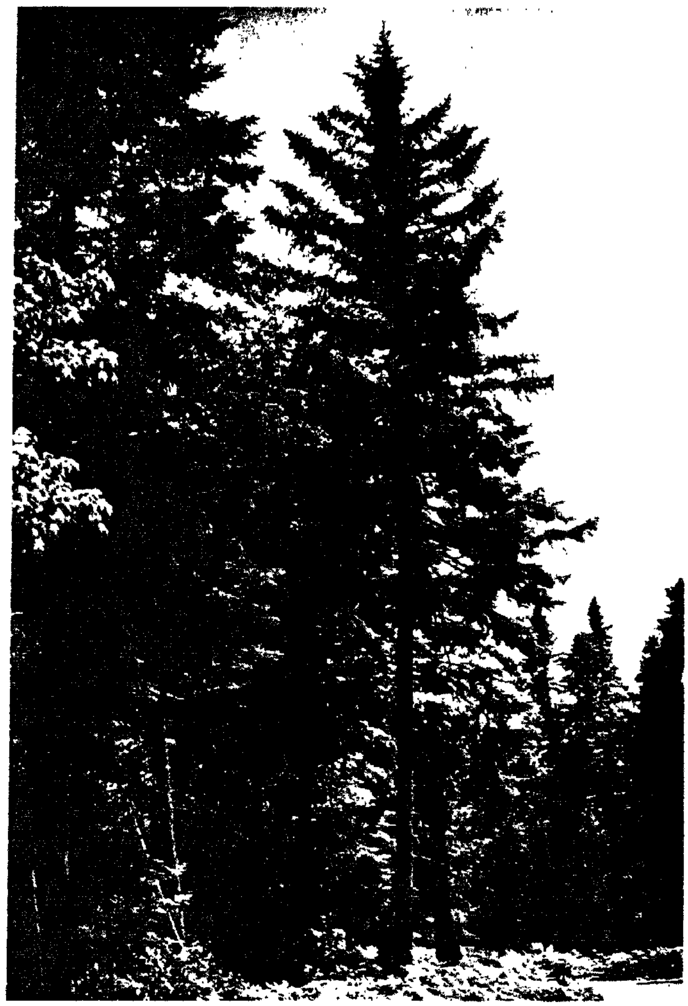
Proceedings of the SYMPOSIUM ON INTENSIVE CULTURE OF NORTHERN FOREST TYPES



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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

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.

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

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CONTENTS

STATUS OF GROWTH AND YIELD INFORMATION FOR NORTHERN FOREST TYPES

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Abstract

Existing regional growth-and-yield information for most of the northern forest types is summarized by species. Present research is concentrated on growth-simulation models, constructed by either aggregating available information or through individual tree growth studies. A uniformity of more refined measurements is needed so that future growth models can be tried for other species and forest types.

MOST FOREST-MANAGEMENT decisions include some form of growth information, because cultural treatments on different sites cause growth responses to vary. Growth data are not only some of the most sought after information, but also are some of the most difficult to obtain. In order to report on the status of growth and yield information in northern forest types, it is necessary to realize that different forest types are comprised of many species within that type and that each species grows at a different rate. Each species has its own growth rate in height and diameter; and these rates depend directly upon site, moisture, and competition.

DESIRED GROWTH AND YIELD INFORMATION

The information desired most frequently would be used to predict the long-term influence of site, stand density, and silvicultural systems on the growth and yield of different stands in terms of product objectives. The long-term growth and yield predictions are desired for managed and unmanaged stands growing on different sites for varying periods of time.

Yield information is also needed for different silvicultural treatments used for different management objectives. In addition to different growing conditions, one needs knowledge of yields by product classes, including various portions of whole trees. Thus for growth and yield information to be meaningful, different aspects of tree growth--from fiber production to high quality sawlogs--must be considered. These products should be described within a framework of growing conditions and time requirements needed to achieve the desired product or measurement classes.

AVAILABLE GROWTH AND YIELD INFORMATION

Classical growth information has been developed for diameter and volume growth measured at 4.5 feet above ground, or volume growth of the whole bole by age classes.

The growth information available is primarily stand growth over an average set of conditions, usually for a relatively short period of time. This seems logical because it is impossible to collect data from various aged stands, with different silvicultural treatments, growing on different sites.

Existing yield tables are of two types. Normal tables, based on unmanaged stands at maximum or full stocking, show yields attained at various stand ages. The other type is empirical tables, which are constructed over the life of the stand, representing average stocking that may have varied greatly at different periods.

Normal tables are poor indicators of attainable product yields from thinned stands, while empirical tables do not give accurate estimates for long-term conditions unless stands are grown under the same conditions as those on which the tables were based. Yield information available gives harvest volume by age class and frequently by site index or class.

The major northern forest types recognized by the Society of American Foresters (1954) are: aspen-birch-pin cherry; white pine; swamp conifers; spruce-fir; and northern hardwoods. As a means of reviewing existing literature, I will discuss the growth and yield information for each of these forest types. This review of growth and yield information is not complete, and it is not intended to include all available sources of information. My purpose is to try to report the most recent or the most significant literature dealing with growth and yield in the northern forest types.

Within the aspen-birch-pin cherry type, almost pure stands of individual species occur. Therefore I will review existing growth and yield information by each species. For birch in New England, early information is available from Dana (1909) for natural uneven-age stands. Height, diameter, and volume growth are given by age and regeneration classification. Yield is given by age and quality class.

Diameter growth data for young managed birch crop trees with different degrees of thinning are presented by Solomon and Leak (1969). Merchantable volume yields are also given for even-age stands of various mean diameters and the number of years to reach that mean stand diameter by site index for managed and unmanaged stands. Normal yield tables for birch stands in the Midwest were reported by Plonski (1956); these tables give yield by site class, age, height, diameter, number of trees, and basal area. The same information for well-stocked aspen stands is presented in a similar manner. Information about aspen stands in the Midwest is given by Schlaegel (1972). He presents net periodic annual basal-area growth by age and stand density. Also, yield information is presented by age, site index, thinning regime, and stand density.

For white pine in New England, we have yield information for well-stocked stands (Frothingham 1914), and for old-field plantations for different locations by age and site index. The most recent yield information is given by Leak and others (1970) for white pine in New England related to age, site, and stocking. Although this and other yield information are available for white pine, extensive stand-growth information does not seem to be available. What growth information is available in the literature is for specific areas and is not presented by alternative management criteria.

For natural stands of red pine in the Lake States, extensive growth information by age, site index, and stand density are available (Buckman 1962). His tables present basal area, net growth, cubic feet, cordwood, and board-foot growth by site index, age, and stand density. Yield information is also presented, by site index, age, and stand density for various residual thinning densities.

Yield information for jack pine in the Lake States, along with cordwood growth and basal-area growth after thinning, is available by site and age (Eyre and

LeBarron 1944). Gevorkiantz (1947) published yield information with growth rates by size class and conversions for less-than-normal stocking. Later, normal yield tables for jack pine in northern Ontario were developed by Plonski (1956). Therefore, tables by site and age are available for a wide range of stand densities and varying silvicultural treatments.

Since the Lake States have stands of predominately black spruce with a low mixture of other spruce species, black spruce will be discussed separately. The growth and yield of black spruce in the Lake States is available for managed stands by age, site, and basal-area density (Perala 1971). From these data, equations have been developed for estimating growth and yield for both cubic feet and cords. Also, normal yield tables are presented by site and age (Plonski 1956). Diameter growth by stocking and size class, and basal-area growth for various residual stand densities of the swamp conifers, are also available (Skilling 1959).

In addition to black spruce information, stand volume growth, and yields by age, site, and competition indices are available for balsam fir (Gevorkiantz and Olsen 1950). Growth and yield information for spruce and fir stands in the Northeast started in 1917 with Murphy's (1917) work on old-growth and old-field red spruce. This work included diameter growth by size and stand type for different locations throughout the Northeast. It also contained basal-area growth by age and quality class.

In the Northeast, both normal yield tables by Meyer (1929) and empirical yield tables by Westveld (1953) are available for spruce-fir stands. The normal tables are by age and site index for different species. The empirical tables are given by age, using a density and stand-composition index.

Average cubic-foot stand growth rates for spruce-fir stands have been presented for New England (Safford 1968). The averages are presented by density, height, and type of stand mixture. Yield information is presented by Merrill and Hawley (1924) for hemlock stands in southern New England. Cubic-foot and board-foot measures, and current annual and mean annual increments, are given by age and quality class. A more recent publication by Baskerville (1965) has given production of balsam fir stands in New Brunswick in both cubic feet and weight for different tree components for varying number of stems per acre.

Growth information for northern hardwoods began with diameter, height, and volume growth for stands in the Lake States and yield information for the Northeast (Hawes and Chandler 1914; Frothingham 1915). Both the growth and yield information is for fully-stocked stands by age and site differentiation.

Later additional normal yield information was presented by Spaeth (1920) and Gevorkiantz and Duerr (1937). These provide yields by age and site classifications for both the Lake States and New England northern hardwoods.

Yields for managed stands in New England have been combined and presented by Leak, Solomon, and Filip (1969). Their tables make use of existing information, both published and unpublished, for northern hardwood stands and present the number of years required to reach a specified yield by site index. Growth information for stands under different forms of management is given by Erdmann and Oberg (1973). Also Solomon [in press] has compiled stand growth responses for northern hardwoods in New England, by size class for different densities in uneven-age stands.

It becomes apparent from the partial listing of existing growth and yield information that much work has been done. Hence arises the question of "Why do we need more?" Why not just revise or adjust existing information?

FUTURE GROWTH AND YIELD INFORMATION

The general comparison of the desired growth and yield information with the actual published information indicates the intensive need for data, especially for managed stands. Since no two stands are alike, the need arises for the forest manager to have separate growth and yield information for stands of different species composition growing under different levels of stocking.

Stand information is usually based on average growth and yields over a large area. A broad average usually ignores many of the differences between individual stands. Thus one of the functions a land manager has is to determine how close his stands are to the reported average conditions.

Therefore, to estimate future growth rates and yields accurately and make meaningful forest-management decisions, the land manager needs information about the response of his stands to a variety of environmental and physiological conditions. He needs single tree information rather than broad averages for specific local cases. The use of individual tree responses to develop an average for a whole stand should provide an equally reliable base for future growth estimates.

There have been two basic approaches toward fulfilling the need for determining forest growth and yield under different silvicultural systems on different sites. Both approaches employ simulation models of actual responses. One method is to use stand growth and yield data for different conditions and combine them into a stand model. The second method is to take specific data, usually individual tree growth, and develop stand responses.

As you can see from existing information, stand results are not reported on a similar basis, which makes the first method of comparison or combining difficult. Also, species combinations for mixed stands are most difficult to deal with.

Various stand growth and yield simulators have recently been developed for the northern forest types. Moser (1974) has developed a system of equations for forest stands of sugar maple in the Lake States. Solomon (1974) presented a simulation model for different silvicultural treatments of even-age northern hardwoods in New England.

The method of modeling that uses individual tree data allows significantly more flexibility; however, it requires more time to develop, and extensive field calibration. Many different individual tree models are available (Arney 1971; Beck 1974; Lin 1974; and Mitchell 1969). Simulation models have been developed for the northern forest types relying on different expressions of competition and growth. Hegyi (1974), for example, has developed a model for managing jack pine. Likewise Ek and Monserud (1974) have provided a model that deals with mixed species in even- and uneven-age stands.

Ongoing growth and yield research within the northern forest types is attempting to use individual-tree information together with stands to construct models.

Another urgent need is for the forester to measure products in more specific units. If we are to intensify our tree growth we need to know the responses of different tree components and how to measure this response. For example, volume, as measured by cords, is unsatisfactory for branches or leaves (Young 1973). Therefore we should bring the forestry world to a more common and precise basis, such as cubic meters, cunits, or weight. We need to be able to communicate as well as understand.

SUMMARY

For the land manager to manage his forests intensively, he needs growth and yield information for different species in mixed, even-age, and uneven-age stands on different sites with varying degrees of density and stocking. These stands need to have different combinations of these conditions both for managed and unmanaged stands.

Available growth and yield information deals with normal stands and some segments of managed stands. There is not only a need to develop growth responses for trees growing under different environmental conditions: there is also a need for collecting data and reporting results on a more common and conforming measurement basis. Therefore, the development of simulation growth models, as is being done, seems the most logical path to follow in an attempt to bridge existing gaps.

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