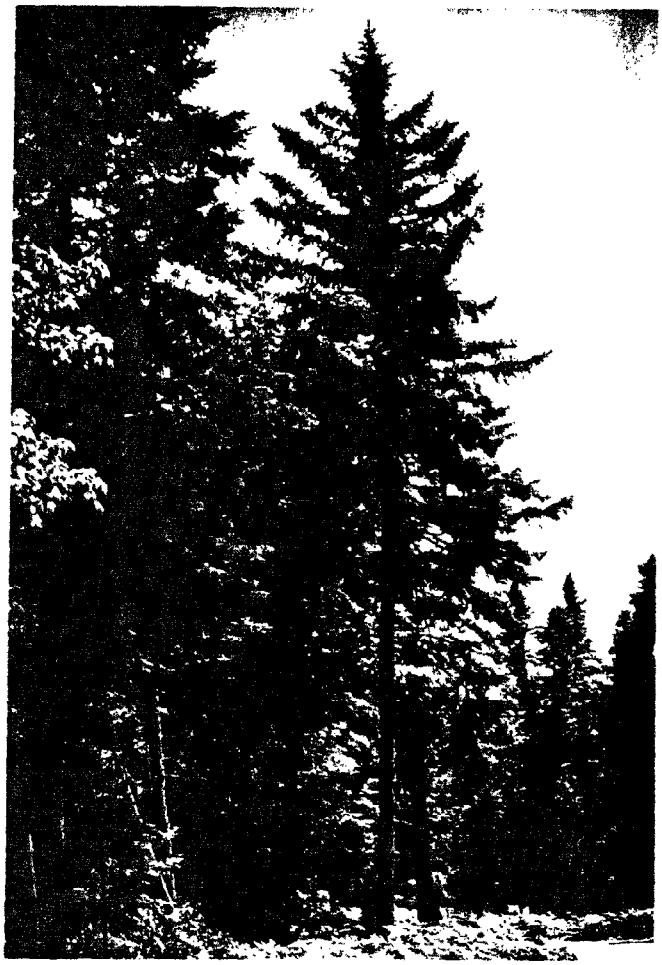
Proceedings of the SYMPOSIUM ON INTENSIVE CULTURE OF NORTHERN FOREST TYPES



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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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Dick Kennell, USDA Forest Service, State & Private Forestry: 21 July 1976, afternoon session.

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

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ARTIFICIAL REGENERATION; APPLICABILITY, OPTIONS AND RESEARCH NEEDS

by

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Abstract

In this overview of the status of reforestation in the northeastern United States, the applicability of natural regeneration is compared to planting and direct seeding. Foresters are urged to conduct careful planning of reforestation and to use harvesting as a silvicultural tool. Landowners are cautioned against the use of clearcutting unless they are prepared to use artificial regeneration measures. Research in the economics of reforestation options is recommended and the importance of forest genetics research to the regeneration phase of intensive forest management is emphasized.

One of the major decisions to be made in the sustained yield management of any plant crop is how to first establish it and then how to replace it after harvesting. Most so-called "cultivated plants" require much human assistance, not only in their establishment, but in subsequent survival, maintenance of genetic identity and continuance in usefulness to mankind. Only a few species of cultivated plants provide the world population with the bulk of its food. They have little resemblance to their wild ancestors and are biological monuments to man's long-term efforts in selection, introduction, breeding and intensive management.

Conversely, tree species yielding most of our world's wood products are essentially "wild plants" and persist as a residua of man's exploitation. The northern forest types of concern to this symposium contain no exceptions. They consist almost entirely of indigenous species which have attracted little attention to improve or even preserve their existing genotypes and they have not been intensively managed except experimentally or on a small scale.

NATURAL REGENERATION

Although the records show that nearly two million acres have been planted to trees in New England and New York, most of this has been done on abandoned farmland and forest landowners in the Northeast have concerned themselves but little with artificial regeneration as an alternative available to them in re-establishing forest types following logging. Trees eventually replace trees and most resulting species have been marketable. Thus we have relied upon the resilience of the land to return to us, through succession, a new crop for an old one. Nature, in serving its purpose, has generally satisfied ours for we have not been sensitive to setting standards of composition and stocking which were very demanding of either of us.

Although natural regeneration, when unplanned and unaided, is highly erratic and unreliable as to timing, species, density and distribution, regionwise it has provided a surplus of wood and only following forest catastrophies has our confidence in it been badly shaken. Therefore, it is understandable why people have not pressed for a departure from the traditional dependence upon wild seeds, sprouts and suckers to renew a wild crop.

These are generalities, and are not meant to imply that management of all our woodlands are without purpose, planning or provision for replacement. To the contrary, much progress has been made during our professional lifetimes in promoting those forest practices which at least tend to preserve the status quo of most of our northern forest types. Improved forest protection, more and better access roads, conservative cutting practices, professional custodianship, free consulting services to small landowners and productive research are among the achievements which have helped to move us from the purely exploitative operations of the past toward a more intensive form of socially-oriented forest management. But our achievements have been too few and we should consider our progress with professional discontent, especially from the silvicultural viewpoint. A critical analysis of the status of our regional silviculture would pointedly indicate courses of action and choices of options not necessarily new nor novel but more publicly popular and more privately profitable than those now being followed. No analysis should be necessary to convince us that we should abandon our

dependence upon unaided natural regeneration before we are forced into doing so by legislation, as has been the case in several western states.

Choosing the proper silvicultural method of natural regeneration and applying it as intensively as needed should probably be the first reforestation option of many landowners. With most of our major species, ecological knowledge and silvicultural experience are adequate to the task. In those instances where they are not, research to correct such deficiencies should be conducted. However, if man-aided natural regeneration is to satisfactorily serve our purposes, we must adopt a new philosophy toward silviculture and harvesting. They cannot be treated as separate activities as they generally are today. Continuance of the practice of permitting "logging" to primarily serve as a means of removing forest products to keep paper mills and lumber producing plants in operation should not be condoned. Logging must become a management technique and a silvicultural tool or the harvesting will continue only as managed exploitation; and forest re-establishment will be little influenced by silvicultural options of natural regeneration methods. Artificial regeneration will then be mandatory to replace preferred species at proper densities without undue delay.

Natural regeneration methods have the reputation of being less expensive than planting or seeding but they are never free and may not be the cheapest. If we use them, then we should not only carefully evaluate their successes but also compute their costs in order to make proper choices between them and to compare their application with other alternatives. Examples of such comparisons with species of other regions have appeared in recent literature. McDonald (1976) has discussed costs associated with the seed-tree method in regenerating ponderosa pine (Pinus ponderosa) in California. He challenges the belief that this method, which is especially appealing to small landowners, is necessarily cheaper than planting because of such factors as: (1) direct costs resulting from the inhibiting effects of the seed trees; (2) negative effect of advance growth on seedling survival; (3) decrease in stocking and density of regeneration caused by seed tree removal; and (4) increase in logging costs.

Loblolly pine (Pinus taeda) the most intensively planted species in North America, is also successfully regenerated by the seed-tree and shelterwood methods. The decision, therefore, as to the proper method to use is an economic one and Sundry and Lowry (1975) have presented some interesting case studies relating to this decision-making. Important factors influencing the cost of the two natural methods and not tree planting were those associated with: (1) delay in regeneration; (2) tree marking; (3) seed tree (opportunity costs); and (4) pre-commercial thinnings. Costs attributed to delayed regeneration were particularly important to the choice of method, even at relatively low interest rates.

These references are cited to emphasize that the use of any reforestation method should represent a compromise between biological success and economic feasibility. Regardless of the method used, whether natural or artificial, its costs should be determined and compared against other methods and against the probability of incurring a greater cost in the future if no regeneration is planned.

ARTIFICIAL REGENERATION

Planting of Nursery Stock:

The Northeast played a leading role in the early history of reforestation in the United States. The Massachusetts State Nursery at Amherst, established in 1907 (operations terminated in 1970), was one of the first American sources of forest planting stock. Also the state nurseries in New York were once among the nation's leaders in seedling production and innovative techniques of nursery culture.

Low land values, large acreages of abandoned farmland, cheap labor and substantial subsidies helped create a custom, sustain a cause and develop a culture for which there now seems to be little regional demand. The Soil Bank Program of the 1950's stimulated planting but there have been no subsequent instances of motivating circumstances, except for Christmas tree propagation, sufficiently adequate to offset the lack of easy planting sites (those not needing site preparation), increased land values, expensive seedlings and high planting costs. Consequently, the average annual acreage planted in New England and New York has been only about 6,000 and 13,000 respectively, for the past decade and

has not increased significantly during the last five years (Table 1). Thus, planting of bare-rooted stock has been largely confined to restocking old fields and pasturelands and is a low-priority option of forest landowners. It is rarely used as an alternative to natural regeneration in revegetating cutover woodlands and its contribution to intensive forest management in the region is inconsequential. It is interesting to note that this situation exists even when three of our prominent northern species (Pinus strobus, P. resinosa, Picea glauca) and two European ones which thrive here (P. sylvestris and Picea abies)constitute five of the top ten species planted in eastern United States.

Table 1. --Acreage of Forest Planting in New England and New York, 1966-1975 (U.S. Forest Service 1961-75)

State	Acres Planted 1966-75	Avg. Annual Acreage Planted (rounded) 1966-75	1971-75
Connecticut	16,302	1,630	1,950
Maine	20,439	2,040	2,030
Massachusetts	6,302	630	440
New Hampshire	8,657	870	1,030
Rhode Island	2,767	280	290
Vermont	7,133	710	670
	61,600	6,160	6,410
New York	128,262	12,800	13,780

Direct Seeding:

There is also a noteworthy record of this region's involvement in direct seeding. Extensive sowing of pitch pine seed on Cape Cod during the mid-1800's was undoubtedly the first operational direct seeding in this country. Research in contemporary seeding has been conducted by several investigators, beginning in the late 1950's, and in 1964 knowledge gained to that date was presented at a symposium on Direct Seeding in the Northeast. Since then, workshops have been conducted, seeding machines developed and papers published on additional research.

Thus, it has been demonstrated here and elsewhere that direct seeding of some northern species can be successful and could be included among our options of regeneration methods. However, in a recent state-of-the-art paper (Abbott, 1973) it was pointed out that direct seeding was of no practical importance to forestry in northeastern U. S. because it wasn't being used. Only 1162 acres were seeded from 1961-71, a period during which 2.5 million acres of direct seeding accounted for 14% of the land area reforested in the U. S. (Table 2). The regional situation remains unchanged, for less than 100 acres have been sown each year since then.

Table 2. --Contribution of Direct Seeding to Reforestation in the U. S., 1961-1975 (U. S. Forest Service, 1961-75)

Year	Total acres (M) reforested	Number acres (M) direct-seeded	Percent of area reforested by direct seeding
1975	1,930.4	131.5	6.8
1974	1,603.5	166.7	10.4
1973	1,749.7	200.8	11.5
1972	1,680.2	224.5	13.3
1971	1,692.9	242.9	14.3
1970	1,599.8	263.5	16.4
1969	1,457.5	224.6	15.4
1968	1,468.6	218.0	14.8
1967	1,407.7	182.0	12.9
1966	1,319.8	178.8	13.5
1965	1,325.0	188.8	14.2
1964	1,353.6	184.0	13.5
1963	1,362.7	221.5	16.2
1962	1,402.1	210.9	15.0
1961	1,796.2	181.4	10.1
	23,149.7	3,019.9	13.2

Although several factors have contributed to a national decline in the area seeded (Table 2), direct seeding continues to be very important in several states. There are those who believe that it has not

been given a fair chance to prove its worth, even in the South, where it has worked well. The major reason why it is not used more by southern foresters has been recently attributed to their reluctance to recommend it. They don't use it because they lack knowledge and experience of how to do so. They object to its use chiefly because they feel it is too technical (Kerr, 1975).

The disadvantages of seeding are well-known, but they are sufficiently over-shadowed by its advantages to earn it a place among our reforestation options in the Northeast. It is the fastest, cheapest, and least labor-intensive of our artificial regeneration practices. It seems unreasonable not to give it an opportunity to serve us simply because we don't know how to use it properly, are unwilling to gain experience with it, or consider it too technical.

Although it is especially adaptable to small woodlots, the principal use of direct seeding in the South and West has been on large, contiguous areas and it is especially applicable to reseeding newly harvested lands as a supplement to or substitute for natural regeneration. It would appear, therefore, that direct seeding has the potential to become very useful to us if we were more receptive to it.

Planting of Container-grown Seedlings:

The third and newest mode of artificial regeneration available today consists of planting small seedlings grown in individual containers in a greenhouse. Given several names in the past under the general title of Container Planting, it is perhaps most precise to refer to this method as "planting of container-grown seedlings" since these trees may be set out in the field either in their containers or without them.

Largely ignored by foresters in the U. S. until after several years of operational use in Canada, planting of container-grown stock has become popular in the Pacific Northwest where it is estimated that over 90% of such stock is being grown. Production has increased from less than a million plants in 1970 to nearly 50 million or 20% of that region's planting stock in 1976 (Ter Bush, 1975).

A North American Containerized Tree Seedling Symposium was held in 1974. Its proceedings and other forestry literature contain many reports on this subject, and an excellent article in the Journal of Forestry (Stein et al.1975) presented an outlook for using this method and described the state of its art.

There are numerous reasons why planting container-grown seedlings is attractive, even though it is likely to be the most costly. Southern foresters are interested in it primarily for the purpose of extending their planting season. Some tree species are difficult to raise in nurseries and are more easily grown in containers in the greenhouse. There is hope for better survival and growth over bare-root stock and greater production and planting efficiency are promised.

It seems more than coincidental, however, that in the region where container seedling production has thrived, forest management is being intensified and increases in reforestation are motivated, at least in part, by laws requiring it. Also, foresters in Washington and Oregon, the two leading states in total acres of direct seeding, have been forced, involuntarily, to curtail this practice because of restrictions on the use of chemical seed protectants and pre-baiting poisons used to reduce small-mammal populations.

Greenhouse facilities permit the growing of seedlings on more flexible schedules, can be constructed quickly and economically and require only about 5% as much area as do conventional tree nurseries. These are important features where good nursery sites are scarce and new planting programs are planned. These features can make the container seedling method particularly appealing to industrial foresters of the Northeast whose companies are interested in intensifying their forest management. Two such companies in Maine have recently become involved in container seedling propagation.

RECOMMENDATIONS

Natural Regeneration:

The biggest step forward, regeneration-wise, toward more intensive forest management in the Northeast would be to take the necessary action to assure

that no harvesting is conducted without sound plans for obtaining prompt replacement with a well-stocked crop of commercial species. If landowners do not volunteer this action or are not soon educated to do so, they will eventually be legislated into it. In this respect, the long-range good of society must take precedence over the short-range objectives of property owners. If foresters fail to adopt this philosophy toward our forest resources, then they will generate new restrictions on their options of operations and they will bring about the relinquishment of land-use leadership to others more willing to do so.

With the exception of clearcutting of large areas, methods of natural regeneration, if properly applied, should result in satisfactory crop replacement when mature stands of preferred species are timely cut. However, pre-harvest cuttings, site preparation work and even supplemental seeding may be needed to insure prompt establishment of the new stand.

Although the clearcutting method may not only give acceptable, but also the best results of all our options when applied on small areas of proper configuration, we should be cautious in its use. Criticism and punitive action by the public against this method, whether justified or not, can eclipse the benefits gained from it and eventually delete it from our directory of options or place even more inhibiting restraints upon our management practices. Geographical location, personal preference, nor professional dogma cannot for long isolate us from the opinions of an increasingly critical public. Clearcut harvesting, as distinct from the clearcutting method of regeneration should not be allowed and we could enhance our professional image, create more forestry jobs and promote intensive forest management if we were the initiators of regulations to prevent it.

Future Role of Artificial Regeneration:

Therefore, what is the future role here of artificial regeneration? Will it become an integral part of intensive management of northern forest types?

We probably will continue for more than a decade to use it only sparingly throughout the region, except for such crops as Christmas trees and the unique

involvement by a few of the more progressive industrial landowners. This situation will continue as long as: (1) no legal obligations force a change; (2) primary wood processors continue to enjoy a large land base from which to harvest wild crops; (3) there is a surplus of available wood; (4) no forest catastrophies occur; and (5) landowners, particularly forest industry, are not presented with some special circumstance of monetary motivation to intensify their management. The last three of these criteria are particularly vulnerable to change, at least in some areas and with certain species and types.

A need for doubling the nation's wood production in 20 years has been predicted and if this transpires, then the scarcity of supply and escalation of prices of preferred species will force cultural changes.

As a professor of forest protection, I must make a pitch for those practices which are the only reasonable cure for correcting such excessive losses of forest crops as those caused by windstorms, wildfires and epidemics of insects. The first two are always a threat, the third is a reality and all are interrelated. It took forty years to reforest the Tillamook Burn in Oregon, even with the aid of artificial regeneration. We certainly cannot tolerate such a reforestation timetable of any comparable catastrophe in the Northeast, and we should be prepared to plant or direct seed if we have one. The spruce budworm epidemic and the fire hazard of its aftermath are ecological phenomena sufficient by themselves to force us into readiness and willingness to use artificial regeneration or else to forsake any plans for intelligent intensive management.

Money motivates management. Therefore, benefits to the landowners from artificial regeneration should exceed the costs and until they do, there will be little enthusiasm for it. Changes could be made in the Forestry Incentives Program to encourage more intensive reforestation on small woodlots, such as cost-sharing for site preparation and acceptance of direct seeding as a substitute for planting. Cost accounting procedures by large landowners who process their own wood may undergo changes when their balance sheets between harvesting and regeneration show a growth-drain ratio which necessitate increased reforestation to support their wood demands.

Research Needs:

Research needs in artificial regeneration should be considered within the total context of intensive management. What is needed most is new knowledge which will help forest landowners make a profit growing trees under the many sociological, economic, and biological constraints with which they must contend.

A culturally sound and economically attractive method of reforestation may have limited utility if it is flawed by a factor which makes it unacceptable to society. We have recently been shown some classic examples in this regard, such as the curtailment of direct seeding by regulations restricting the use of chemical rodenticides and seed protectants. Also, tree planting following clearcutting of large areas, though profitably appealing and professionally preferred, has offended the public and produced its own problems. Other, less notable, cases could be cited but these should suffice to accentuate the need for a new forest research perspective -- a perspective which includes people as well as practices. We must learn how to make what we do in the management of forests seem right to others, which points to the need for "communications research."

When several methods of regeneration have proven culturally successful and the decision as to which to use is an economic one, then information on costs, both cash and compounded, must be made available on all options and their supplemental or supporting activities. Because of the dearth of such information on regenerating our northern species, research in the economics of reforestation is recommended.

If we measured what we know against what we do not know of the ecology of our northern forest types and species, the results should shock us from any complacency with our existing efforts in biological research. The opportunities and needs for such research are many but I will name only one subject-matter area -- forest genetics -- for the silviculture of intensive management must be based upon genetic principles. The intensive selection and breeding of trees require artificial regeneration, which in turn is dependent upon the application of genetics to provide it with high quality seed (or other propagules) from good genotypes. Hence, research in

forest genetics must receive top priority and should be planned and supported on a Cooperative basis as it has been in the South.

CONCLUSION

I have presented this overview of our reforestation situation, not to be critical or condemnatory of it, but to place it in perspective. For I sincerely believe that unless the regeneration phase of forestry is given proper consideration, the management of our northern forest types cannot become truly intensive.

Foresters must eventually emulate those achievements of their agricultural counterparts who have developed a successful culture of "cultivated food plants." Fiber from the forests of the Northeast will perhaps some day make its mark in the millenium of mankind when the species from which it comes, though still resembling their wild ancestors, can be called "biological monuments" to man's efforts to tame them through intensive management.

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