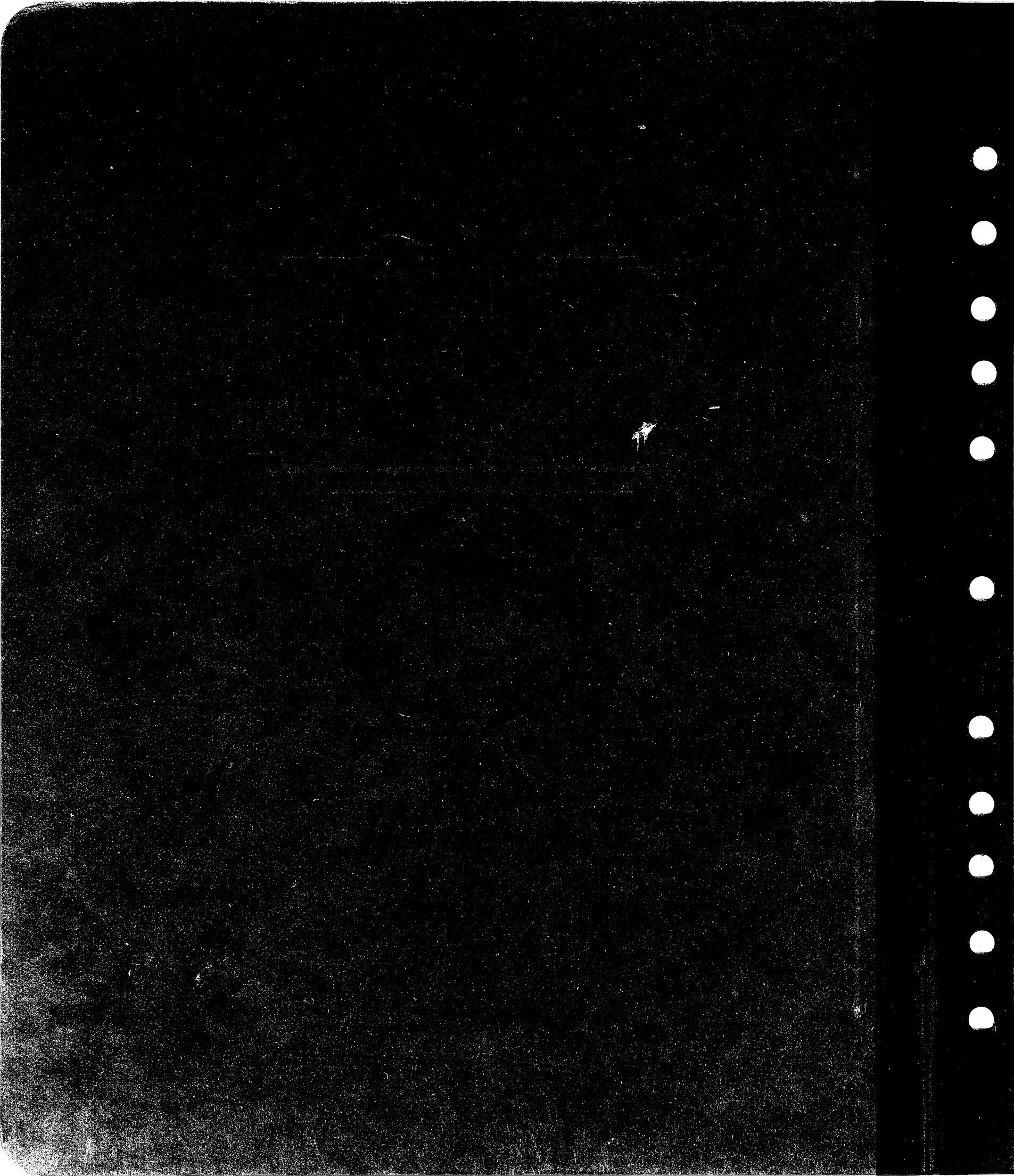


CONIFEROUS PLANTATION MANAGEMENT
PROBLEMS IN LOWER MICHIGAN

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by

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CONTENTS

	Page
Purpose and Scope of Study.....	1
Plantation Problems and Needs in the Lake States - A Review and Analysis.....	2
Plantation Problems- Their Relation to Plantation Development.....	4
Site Preparation and Planting Stock.....	5
Planting.....	5
Adaptation and Initial Establishment.....	5
Growth and Development.....	8
Special Problems of Growth-Suppressed Plantations.....	9
Field Observations-Huron National Forest.....	11
Higgins Lake State Forest.....	12
Silvicultural Questions- Why Underplant.....	13
Response to Release Cutting- A Study.....	14
Competition and Dominance.....	26
Volume and Quality Growth.....	26
Maturity.....	27
Field Studies: The Fransblau Plantations.....	27
Summary and Conclusions.....	48
Literature Cited.....	50

Purpose and Scope of Study

The purpose of this study was to investigate problems of forest plantation management, particularly problems of after-planting care, in Lower Michigan.

This paper reviews the subject of forest plantation management from the early years of planting to the beginning of merchantability. Greatest emphasis is placed on study and analysis of plantations suffering from neglect in one way or another. The data and observations approach the subject both in general and in terms of specific examples investigated in the field.

Field work included: (1) Detailed studies of three forest plantations near Ann Arbor, Michigan. Data taken in study of these plantations illustrate the need for after-planting care. (2) More general observations on the Higgins Lake State Forest and the Huron National Forest, both in Lower Michigan. Discussion of these more general observations emphasizes the need of plantation release from hardwood competition.

PLANTATION PROBLEMS AND NEEDS IN THE LAKE STATES -
A REVIEW AND ANALYSIS

During the past forty years, thousands of acres of forest plantations were established in the three Lake States of Michigan, Wisconsin, and Minnesota. At the end of 1944 the acreage planted in these states totaled 1,393,000. 2/ Since these plantations were established, many have progressed satisfactorily. Others, however, have suffered from various agencies including drought, insects, disease, poor seed, rabbits, mice, white grubs and climatic factors. In the early 1930's it became increasingly apparent that many plantations were suffering from severe competition.

Through lack of timely weeding, thinning and other cultural treatments, the development of many young plantations had been seriously retarded. In some cases, initially successful plantations were doomed to eventual failure. The Lake States Experiment Station issued a bulletin in 1935 which described this situation. 3/ Partly at fault was the idea that a plantation once set out in the field no longer needed care and without further attention would grow into a mature forest. In other instances, early difficulties such as heavy mortality of seedlings may have discouraged plantation owners. In the case of state and federal lands, lack of funds were often the reason. Causes for neglect, or lack of care, were and are

many, but the important fact is that without adequate care, and for whatever the reason, many present plantations will fail.

On January 7, 1950, the Michigan Conservation Department reported that in the biggest reforestation program since the war, nearly 12,000,000 trees were made available for planting on state and private lands. The Higgins Lake nursery turned out nearly 7,200,000 seedlings and transplants, the bulk going to farms, industries, schools and communities conducting reforestation projects. Another 4,385,000 seedlings were planted by state forestry crews in ten state forests. In addition, 3,000,000 are scheduled for spring planting. The hardwood nursery supplied 350,000 seedlings for state parks, game areas and private farm game projects.**

If the past is any indication many of these new plantings may suffer for the same reasons older plantations have. Among the silvicultural problems likely to arise will be those resulting from plantations neglected when cultural measures were desirable. These and other important plantation problems must be understood if success is to be achieved with reforestation work.

Foresters should realize there is more to the problem of plantation care than the technical point of view alone.

** Twelve-Million Trees Planted in State. Detroit News, January, 1950

For example, from the standpoint of public opinion, no phase of forest practice is more before the public than planting. Although only a part of forestry, to many forestry is tree planting, and it is here where the profession can win or lose advocates. In short, much public reaction towards forestry rests on success in the field of forest planting. For this reason we should strive for successful plantations through continued management.

Apart from this, however, is the fact that money is often thrown away if a plantation once started is left to grow without further care and treatment. While this paper offers no mathematical conclusions in this respect, nor develops the public opinion point of view, neither are entirely forgotten in discussing the technical angles.

Plantation Problems - Their Relation to Plantation Development

Forest plantations develop along fairly defined steps from the time seed is sown in the nursery, through field planting and on to maturity. Plantation problems are often closely related to these steps, or phases, and accordingly are best understood if discussed in terms of plantation development phases. **

** This development phase outline is, in part, a modified version of an outline proposed by Kobranoff in 1930. 4/

Site Preparation and Planting Stock

This phase begins with selection of seed, considerations of its quality, source and treatment and ends when the actual field planting begins. The phase, in addition to seed problems, covers: stock, its class, grade, care and treatment in the nursery. Planting sites must be thoroughly examined and all environmental factors carefully considered. Selection of tree species to fit these site conditions and the purposes of management must be made. Extreme care on this point is important, for errors can result in plantations such as those shown in figures one and two, page six. In addition, all plans are formulated for ground preparation, planting methods and tree spacing.

Planting

At this stage the plans made for planting are put into operation, the ground prepared and the seedlings planted. In many ways this is the most important phase, for if improper planting techniques are employed later phases of development may never be reached. Or if the plantation progresses beyond this critical stage, high mortality may occur later as a result of careless planting.

Adaptation and Initial Establishment

This phase begins immediately after planting and usually lasts two to three years. Total efforts of the



Higgins Lake State Forest

Fig 1. Thirty-five old white spruce planted
on sandy soil better suited to jack or
Norway pine.



Higgins Lake State Forest

Fig 2. A mixed plantation of jack and white
pine. Site conditions were unfavorable for
the white pine.

planted stock are towards developing a root system and adapting itself to the new environment. It is during this period that drought may take a heavy toll, particularly if the roots are not sufficiently developed or if they have been injured by white grubs in the soil. Competition from sod, hazelnut, brush and other tree species may present great hazards to seedlings. Mice, rabbits and squirrels may take their toll. Fire at this stage can be especially dangerous when the crown is low and in reach of even small flames. Disease, such as the White Pine Blister Rust, *Cronartium ribicola*, may cause infection among the white pine. Periodic checks are necessary to determine what progress has been made or what damage has been caused. Where failures have occurred, replanting may be necessary. The many factors tending to reduce stocking necessitate continued attention for a healthy, fully stocked plantation. Degree of early post-treatment will vary with site conditions, weather and the relative amount of sound judgment used in initial planning and preparation of the plantation. Neglect at this phase, if treatment is necessary, may curtail if not destroy the future usefulness of the plantation.

Where replanting has been neglected relative severity of results will vary. For example, with close spacing with large number of trees per acre, failure of some seedlings may not necessitate replanting, for there may be sufficient

trees remaining with satisfactory distribution. On the other hand, failure may be so high that the entire plantation may disappear. Where failures have been comparatively high, remaining trees if far apart will develop bushy crowns and boles of low commercial value. A young forest requires fairly dense stocking for best form-development of the trees. In addition, a poorly stocked stand where the canopy is slow in closing will not provide adequate site protection.

In plantation planning, costs of possible replanting work should not be overlooked but rather provisions made for such expenses. Past experience serving as a guide might aid in predicting probable replanting costs.

The intensity of American forestry may never reach that practiced in Europe, nor will it be necessary; however, there are minimum standards below which we cannot go in plantation work and still expect successful results. Early treatment insuring establishment of a fully stocked plantation is one of these standards.

Growth and Development

This phase is characterized by rapid growth and development of both root and shoot and by the struggle of each plant with the conditions of environment. The phase ends when the canopy closes. Plantations which have been established under a nurse crop should be released early

during this period, otherwise growth may be stymied. Closely allied to this liberation problem is that of plantations not planted under a nurse crop but suffering from competition with faster growing hardwoods. This need of liberation cuttings forms one of the most pressing problems facing foresters on state and federal land in Lower Michigan today. Thousands of acres of forest plantations are being held back by hardwood trees of various species. Unless the planted trees can be released, the plantations will, in many cases, never produce any quality forest products. Since this problem probably occurs most frequently during the Growth and Development phase and because it is of such importance in Lower Michigan at this time, it is discussed in detail here.

Special Problems of Growth - Suppressed Plantations

The situation can best be described through a work plan written by John L. Arend, Research Forester, at the Southern Michigan Forest Research Center in East Lansing. 1/ The plan proposed that a study be initiated to explore possible methods of releasing plantations from hardwoods for direct comparisons of costs and effectiveness of the release. General conditions were described as follows:

"During the past forty years nearly a half million acres of plantations, mainly red, jack and white pine,

have been successfully established in Lower Michigan. Many of these pines were planted on what appeared to be open land at the time of planting, but now many hardwood species such as oak, aspen and red maple have sprouted up and have overtopped many of the pine. Other areas were planted that supported understocked, scrub hardwoods. These hardwoods are now crowding and suppressing many of the planted pines. During the C.C.C. period when man power was comparatively inexpensive and plentiful, the hardwoods were cut on many thousands of acres to release the pine. On the whole, this release work was beneficial to the pine. Now, however, sprouts from the cut hardwoods stumps have again overtopped many of the pine and additional release is needed.

At the present time man power is expensive. The average woods worker receives about \$8.00 per day. Recent release work, where the smaller trees are cut and the larger ones girdled, has been averaging about two man-days per acre. This does not include transportation and supervision. Thus, not only is the initial release work in plantations expensive, but subsequent releases are very expensive."

As Arend states when labor was inexpensive, much release cutting was accomplished. Now, however, financial conditions are tighter and the cost of labor up. An

economic method of release therefore must be devised and it is partly for this purpose that the Lake States study is being made.

Observations of such suppressed plantations on the Higgins Lake State Forest and the Huron National Forest were made on field trips in preparation of this thesis. Results of these observations are described in the following pages.

Field Observations

Huron National Forest

On the Huron National Forest 35,000 acres of suppressed pine plantations are in need of release from hardwoods. This indicates that more than one of every three acres planted on this forest needs release treatment. Most of these plantations are less than seventeen years old, as C.C.C. personnel started the first large-scale planting in 1933. 5 What has been done to alleviate the serious plantation condition on the Huron National Forest?

A small amount of release cutting has been done through girdling of hardwoods four inches in diameter or larger and cutting those smaller than four inches. In addition, other areas have received some treatment through liberation cuttings where the hardwood trees are given to those who want and will cut them. No direct

income is obtained for the forest but release of the pine is accomplished, leading to probable greater future income. Wood cutters are shown a demonstration area where hardwoods have been cut to the best advantage of the pine. Cutters are then assigned to plantations where they will follow the same practices in releasing the pines. No marking is done by foresters, the only expense involved being that of preparing the demonstration area and issuing a few necessary instructions to cutters. Where this work has been done, it has been done well and to the forester's satisfaction. However, the demand for this low-quality hardwood, mostly scrub oak, has been low and only a small percentage of the 35,000 acres thus released.

Higgins Lake State Forest

The Higgins Lake State Forest, east of the Huron National Forest, faced with the same problem, has 9,000 acres of pine plantations needing release from hardwood competition. These 9,000 acres represent over 51% of all plantations on the forest. In a field trip with District Forester, H.V. Borgerson, many of these plantations were observed where hardwoods dominated the site with slow-growing, suppressed pines in the understory. The primary problem here, according to Borgerson, is finding a market for the low quality oak. When an occasional market is found, trees are sold in a commercial cutting. This forest

had less difficulty selling the hardwood trees during the recent war, but during the past few years, market conditions have not favored the small, low-quality hardwoods. It was noted that much of the hardwood was of better quality than that seen on the Huron National Forest. Photographs on the following pages were taken on the Higgins Lake State Forest and further portray conditions discussed here.

Thus far, conditions of suppressed plantations in Lower Michigan have been described and examples from field trips used to substantiate the discussion. What are some of the silvicultural questions involved, and to what extent have they been answered?

Silvicultural Questions - Why underplant

One question that might be raised is that if plantations established under hardwoods are subject to later suppression, why is underplanting practiced? Is there an advantage to be gained from planting under overhead canopy? Artificial regeneration by either seeding or planting is usually easily accomplished under an overstory of suitable density. An overstory serves as a nurse crop for the introduced plants while they are becoming established. When overstory is dense, artificial regeneration is not successful. A portion of the stand must be harvested before seeding or planting is undertaken, and after the new

stand is established the remaining overstory should be removed. Wales 6/ reports that survival is best under some cover, but this same cover may become inimical to final successful establishment. Protection from direct sunlight seems to be necessary for good survival during drought. Young and Eyre 7/ state that: "Because of the presence in the Lake States of millions of acres upon which the original forest has been denuded or replaced by stands of inferior species and quality, the problem of restoring more valuable species on these areas is of great importance. One method of obtaining this result is underplanting the inferior stands with better species, which are to be released later by cutting all, or portions of the overstory. On some of the state forests in Michigan, and in other places as well, the first step in this process has been taken. In many cases the underplanted species, especially in Michigan, has been white pine, because on many sandy soils a better catch is secured under cover than in the open, and the pines protected by an overhead canopy are less susceptible to damage from frost and weevils."

Response to Release Cutting - A Study

Another important question on release cuttings is to what extent must overstory be removed. Is it possible to remove a portion of the overwood to accomplish satisfactory results or is a 100% release cutting necessary? A study 7/

by Young and Eyre answered this and other pertinent questions. The study was an attempt to determine whether underplanted white pine would react sufficiently to release from the influence of an overhead cover to justify the cutting of such a cover in various ways.

Plots were taken for this study at Higgins Lake, Fife Lake, both in Michigan, and at Birch Lake in northeastern Minnesota. A number of cutting methods were employed to determine which one would give the best results when all factors were taken into account, i.e. the effect upon the growth of pine, the cost of cutting, and the possible financial returns. Conclusions reached in this study are as follows:

" Release cuttings in mixed stands of aspen and young Norway pine are distinctly worth-while cultural operations. The young pine, even when badly suppressed by taller and more vigorous aspen, respond immediately to release in almost direct proportion to the degree of cover removal. Suppressed trees benefit most by such cuttings. The early reaction of the trees released takes the form of an increased stockiness, i.e. diameter growth increases at a higher relative rate than does height growth.

On most dry, sandy sites white pine is benefited during its early years by an overhead cover, but later

growth is retarded. After becoming established it should be released in order to secure satisfactory growth. Its response to such a release is prompt and roughly proportional to the degree of release. However, a clear-cutting of the overhead cover is undesirable because of the danger of increasing damage from weevils. Moreover, if the pine has been left so long as to become badly suppressed it is likely to die if uncovered too suddenly.

Underplanting of white pine on spots occupied by maple and juneberry is inadvisable because of the prolific sprouting of these species after cutting.

Heavy stands of aspen when clear-cut produce a mass of suckers that offer worse competition to the pine than does the original stand, unless the pine is large enough to keep ahead. Partial cutting will probably lessen the production of suckers very materially, but follow-up release cuttings will be necessary if the pine is small. Another method of reducing trouble from root suckers is to wait until the aspen is nearly mature before cutting.

Planting white pine under oak with subsequent release cutting is liable to be an expensive undertaking unless the overstory can be disposed of at a price sufficient to offset at least a large part of the cost of cutting. Oak stands of merchantable size and of medium, but rather uniform stocking offer the best opportunity for successful underplanting with pine and subsequent release cutting of

a partial character. Large openings in such stands should not be planted with white pine, since attempts of this sort have usually failed.

When a fully stocked oak stand is to be underplanted, it should first be opened as much as possible, leaving only enough cover to protect the site and prevent serious trouble from the white pine weevil. Cutting and subsequent underplanting in stands of this kind should be delayed until they have reached merchantable size. The first cut should remove as many as possible of the largest-crowned trees in order to reduce damage to the pines in later cuttings.

Where stands are now underplanted, and release cutting seems desirable the cut should be made as soon as possible to reduce damage from breakage. In such cases cutting should be done when the hardwoods are bare to reduce the danger of killing pines by burying them with slash.

When red oak is removed in a release cutting, treatment of the stumps with creosote will practically eliminate sprouting and the necessity for later cuttings. White oak that is forty years old or more has little or no sprouting ability in the northern portion of the Lake States.

Lopping and scattering of slash have proved to be satisfactory in all cases."

Results of this study were of special benefit to

foresters during the time of the C.C.C. when it was possible to accomplish considerable cultural work in forest plantations. The outlook now, however, is not so favorable, for there is no C.C.C. and funds for such cultural work are apparently inadequate. Labor costs are high. Suppressed plantations present a serious problem and something must be done about it.

Since those concerned directly undoubtedly know of the need for cultural measures in these plantations, the problem narrows down to: continuing the present work, obtaining greater appropriations, finding markets for the overstory species or finding a less costly method to accomplish the release work.

At the present time some work is being done on this problem on both the Higgins Lake State Forest and the Huron National Forest. Judging from conditions observed on these two forests the extent of this work is inadequate.

Appropriations often provide the stumbling blocks, as is true in the present situation. Recently the importance of this plantation problem came to the attention of the public through announcements of a meeting held at East Lansing by leading Michigan foresters. It was announced that although Michigan now leads all states in the number of acres successfully planted to pine trees,

many of the plantations need attention in order to survive.** It is conceivable that if enough voices were raised, public opinion might favor needed appropriations.

Were a market for low quality overwood, of which most of the stands are composed, to open within the next decade a catastrophe might be averted. The outlook, however, promises no such deliverance from the problem. There is a slight hope for those plantations under aspen on the Huron National Forest where negotiations are under consideration for large yearly shipments of aspen. This too is just a possibility. In short, there is little basis for optimism in expecting a market to open for most of the overwood material.

If aggressive searching and study can not lead us to markets, then the answer we may have to settle for is the most efficient and least costly method of killing the overwood trees. The Lake States Experiment Station study under the direction of John L. Arend is seeking this answer.

Having considered one of the more important development problems likely to occur during the growth and development phase, the next major division begins with a more developed young forest.

** Plans Made to Help State Rebuild Dwindling Forests,
The Detroit News, March 30, 1950



Higgins Lake State Forest
Fig 3. (A) and (B). Badly suppressed white
pine under hardwoods.



Higgins Lake State Forest
Fig 4. Many of the suppressed pine plantations
are under aspen.



Higgins Lake State Forest
Fig 5. The oak overstory is small and low in
quality.



Higgins Lake State Forest

Fig 6. On many plantations Norway pine is released from an overstory of jack pine.



Higgins Lake State Forest

Fig 7. Twenty-five year old white pine in need of a release cutting.



Higgins Lake State Forest
Fig 8. (A) and (B). Response to release
cutting is roughly proportional to the amount
of overstory removed.



Higgins Lake State Forest
Fig 9. Norway pine after release cutting where
jack pine overstory dominated
the site.



Higgins Lake State Forest
Fig 10. Jack pine cut from the plantation
shown in figure nine.



Higgins Lake State Forest
Fig 11. (A) and (B). Where overstory is completely removed, growth of the pine is increased most rapidly

Competition and Dominance

As the canopy begins to close, the struggle between individuals becomes keen and differentiation into classes of dominance takes place. This phase usually continues to the end of the stand. In reality it ends at the critical age of the stand, that is, the age at which the total amount of leaf surface as well as the requirements of moisture and nutrients from the soil reaches a maximum. It is at this age that trees planted with curled roots which have apparently been healthy up to this time begin to die out heavily. Plantations which survive this phase, which may last 20 to 30 years, may be considered successful. Thinnings should ordinarily be made during this period as they are needed. Neglect at this stage means money wasted, for much can be done to improve the crop trees. For example, by pruning white pine crop trees when they are small, much valuable lumber can be produced at small cost. Examples of plantations which have passed through phase five without receiving such cultural treatment are discussed subsequently.

Volume and Quality Growth

Natural pruning of the branches takes place, height growth slows down and diameter growth is increased, providing the stand density is such that good growth is possible. This phase may last 15 to 30 years. Continued thinning may be

desirable through this phase.

Maturity

This final phase begins when the stand reaches such size and development that major utilization of its products can begin.

Thus, a plantation passes from stage to stage in arriving at maturity. This phase development outline has provided a framework upon which could be laid some of the important plantation problems. The outline itself should be considered flexible with varying conditions. Such an outline aids in understanding how various problems fit into the life cycle of a plantation. The importance of after-planting care has been stressed throughout, and it is this point that will be further developed by means of examples of plantations which were neglected when cultural treatment was desirable.

FIELD STUDIES

THE FRANSBLAU PLANTATIONS

In order to study plantation management conditions under private ownership, three plantations were selected in Washtenaw County, Michigan. All three plantations are under a single ownership.

Two of the plantations represent near-maturity stands

which had received inadequate treatment since establishment. The third plantation, although the same age as the other two plantations, was far from maturity in size. This third plantation, suppressed Norway spruce under mature hardwoods, might be covered equally as well under the fourth phase, Growth and Development, where such conditions were discussed and examples given from observations on government land. Because of the private ownership aspect and because one owner controls all three plantations, coverage of these is presented here.

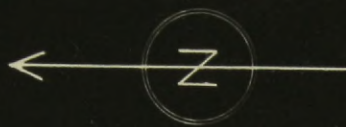
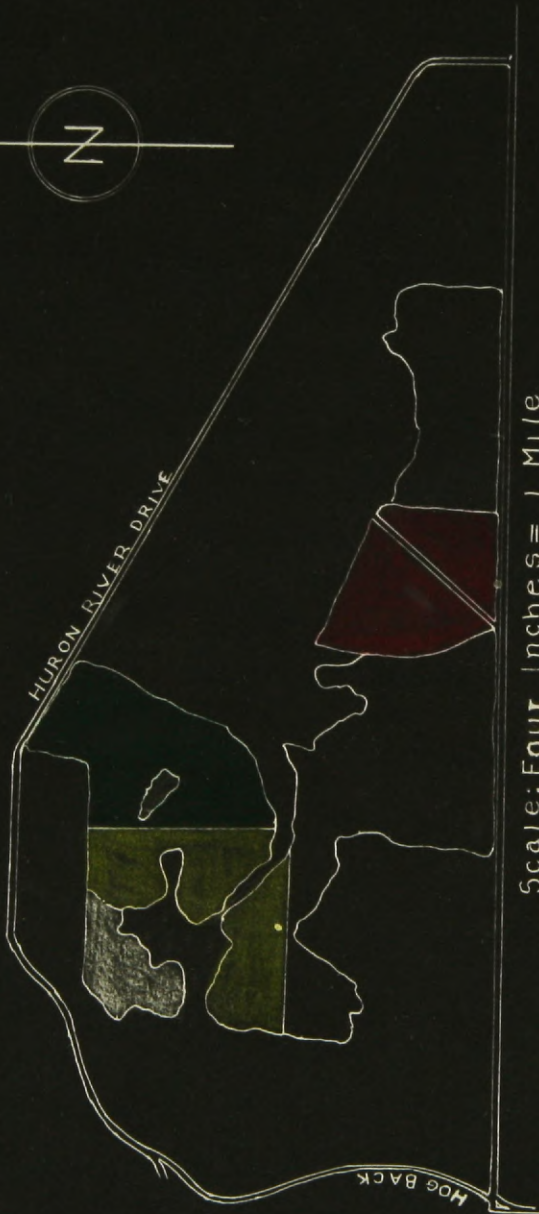
Originally owned by the Detroit Edison Company of Ann Arbor, the plantations were sold to Mr. Fransblau, the present owner, in 1943. The plantations are in Washtenaw County, Range 6 East, Township 25, Section 36, in the southeast and southwest quarters. A sketch of the plantations made from aerial photographs is shown on page 29.

To obtain data on general stocking conditions, seven plots were measured on the pine plantations, designated as Plantations I and II. All trees standing were measured at d.b.h., heights taken of the three dominant trees nearest the plot center and increment borings made. While these data do not represent a statistically significant sample, they do illustrate general conditions. A larger sample should be required for any purposes where explicit management decisions were to be made. This sample made, 1.67%

MAP OF FRANSBLAU PLANTATIONS

WASHTENAW COUNTY, MICHIGAN

1950



Plantation I
W.P.N.E



Plantation II
W. P.N.E



Plantation III
NORWAY SPRUCE

Table 1. - Stocking, Growth and Tree Sizes of Two Coniferous Forest Plantations*

Per Acre Data					Diameter Growth (inches)		Average Diameter (inches)	Average Height (feet)
Plot No.	Live Trees		Dead Trees		Last Ten Years	Previous Ten Years		
	Number of Trees	Basal Area	Number of Trees	Basal Area				
1	325	127.5	25	3.2	1.125	2.750	8.5	40
2	590	181.0	110	5.7	1.000	2.500	7.0	41
3	260	128.5	40	4.7	1.500	1.875	9.3	51
4	290	143.6	30	4.9	1.750	2.125	9.1	42
5	510	155.0	30	2.0	1.250	2.125	7.5	47
6	420	182.0	130	16.5	2.500	2.750	8.5	58
7	170	87.8	10	.9	2.750	2.750	9.4	49

*Composition of plantations--white pine.

was adequate enough to bring out conditions under consideration in this thesis. Data taken on the sample plots is presented in Table 1, page 30.

Description of each plantation will now be given.

Plantation I

Planted: 1908

Tree Species: White pine, Scotch pine, Ponderosa pine and an occasional Norway pine.

Total acreage: 32 acres.

Plantation I can be divided in two parts on the basis of general conditions. The first part, section a., is a plantation of extremely poor quality and represents roughly 20% of Plantation I. Species composition of section a. is chiefly Ponderosa and Scotch pine with a few scattered white pine.

Gravelly, coarse soil has contributed to poor moisture conditions with consequent low stocking. Trees are scattered and in places brush and black locust have taken over the site. Initial mortality in this section was high and replanting operations were none too successful. Scattered trees are of poor form, limby, crooked and stunted. Several wolf trees compete with the pine for moisture and light. No plots were taken in section a., since stocking was obviously low.

It is unlikely that trees on section a. will attain commercial value. Furthermore, little can be done to improve the present plantation.

Section b., nearly pure white pine, is more promising. More favorable moisture conditions are indicated by the healthier appearance of the trees and by higher stocking. However, stocking could not be called satisfactory. Plots 1 to 5 inclusive were taken in this section. Referring to Table 1, 590 live trees per acre on plot #2 present a contrast to the 260 live trees on plot #3. Perhaps more indicative of stocking are the basal area data. Plot #2 has a basal area of 181 square feet per acre while plot #1 has 127.5 square feet per acre. These data point to the varied stocking conditions which are typical of section b. It is believed that were a larger sample taken, results would show that on the whole this plantation is understocked. This opinion is based on data from plantations owned by the University of Michigan. In addition, numerous bare areas throughout the stand diminish total stocking figures.

Radial growth has decreased during the past ten years. Figures in Table 1 show generally, reduction in radial growth has been greatest in stands of higher stocking. Since reduced growth has occurred even on plots of low stocking, other factors in addition to competition could be involved. One authority believes that recent drought years could be

the cause.

Of interest is data on dead trees per acre. The large numbers of dead trees as shown in Table I illustrate the need for thinning. Also, dead trees represent material which might have been utilized if cut.

Typical of white pine, natural pruning is poor. Dead branches have persisted and log quality thereby reduced.

Large, ancient wolf trees scattered through the plantation take up space and have crowded out many of the more valuable pine.

Why this plantation was uncared for was not investigated. Results of the neglect are obvious: stocking is patchy, trees poor in quality, growth rates diminishing and money has undoubtedly been lost.

What can be done to improve present conditions? On section a, an improvement cutting is advisable where crop trees would be selected and favored. Thinning is needed where stocking is dense. Some wolf trees should be girdled. Where pruning might have been highly profitable earlier, it would not be so now.



Plantation I a.
Fig 12. Hardwoods, mostly Black locust (A)
and brush (B) have invaded the plantation.



Plantation I a.

Fig 13. Coarse, gravelly soil has contributed to low stocking because of the poor moisture conditions on such sites.



Plantation I a.

Fig 14. Scotch, Ponderosa and white pine are of poor form on this plantation. Note the large wolf tree at left.



Plantation I b.

Fig 15. Sections of this plantation are densely stocked and in need of thinning.



Plantation I b.

Fig 16. Large numbers of dead trees illustrate need of thinning.



Plantation I b.
Fig 17. (A) and (B). Numerous bare areas in
the plantation contribute to low stocking
figures.



Plantation I b.
Fig 18. Large wolf tree presents competition
to the pine.



Plantation I b.
Fig 19. Many of the white pine are straight,
tall and thrifty but of low quality because
of persistent limbs and knotty character of
the timber.

Plantation II

Planted: 1908

Species: White pine, a few Norway and Ponderosa pine.

Total acreage: 22 acres.

Plantation II, southeast of Plantation I is separated in-two by a strip kept clear for power lines. Soil moisture conditions are better than in either site discussed previously.

Stocking is similar to that in Plantation I b. in that it varies from the dense to scattered. Plots six and seven were taken and illustrate conditions typical throughout the plantation, i.e. varied stocking. Both radial and height growth are better than on Plantation 1b. Radial growth has not decreased as shown by data for plot #7 and only slightly on plot #6. Tree heights averaged higher than those of Plantation 1b. Field mice caused high mortality of seedlings during the early years of the plantation. This may be the reason for the numerous large holes in the stand. Mortality is high, there being 130 dead trees per acre as shown by data for plot #6.

Though wolf trees are present in the stand, there are not many and these are small. The pine trees are of poor form, particularly those with liberal numbers of dead branches

Lack of proper care has caused much of the present difficulty in this plantation. Though needed treatment has long been delayed, the plantation is by no means a complete loss, for much can still be accomplished.

Crop trees should be selected and favored by removing trees crowding them. Trees of especially poor form and those falling behind in growth should be cut. The few hardwoods in the stand are not large and might be left to improve the soil. As in Plantation I b., pruning of crop trees should have been done years ago and would not pay now. Although this plantation has been uncared for in many years, proper treatment now can salvage much of its value.



Plantation II
Fig 20. Forty-two year old white pine
plantation.



Plantation II
Fig 21. Dense white pine in need of a
thinning.



Plantation II

Fig 22. Limby trees are low in value.



Plantation II

Fig 23. Where trees are widely spaced and with full crowns, young white pine reproduction has started.

Plantation III

Planted: 1908

Species: Norway pine planted under mature hardwoods.

Total Acreage: 23 acres.

This plantation represents 42 years wasted insofar as a successful plantation is concerned. The spruce planted under mature hardwoods, mostly red oak, has long been suppressed. Not until 1950 was this plantation released, when most of the hardwood was sold as stumpage.

Growth of the spruce had been extremely poor. A few individual trees have grown to 30 feet but not many are more than 15 feet in height. Stocking is spotty, but low on all sections of the plantation.

If recovery after release were possible after forty-two years, logging has reduced such chances, for many of the underplanted spruce were crushed when the hardwoods were removed.

Since the hardwood overstory was composed of trees long overdue for cutting, original plans were presumably to cut them after establishment of the spruce. Failure to do this resulted in a plantation of stunted spruce, and all efforts expended in establishment of the plantation have been wasted.



Plantation III
Fig 24. Planted in 1908, these Norway spruce
were not released until 1950



Plantation III
Fig 25. Norway spruce under hardwoods.



Plantation III

Fig 25. Many spruce have been burried underneath hardwood slash.



Plantation III

Fig 26. Careless logging resulted in further injury to the spruce.



Plantation III

Fig 27. Most of the underplanted Norway spruce are small and spindly.



Plantation III

Fig 28. Portable mill used to saw hardwood logs from trees removed in the overstory.

These three plantations have served as examples of forest plantations suffering from several problems, most of them caused by insufficient care. In brief review, this neglect has influenced present heterogeneous stocking through failure to thin the stand where needed and failure to girdle wolf trees. Replanting, though attempted did not succeed in filling in all failed areas. Failure to prune selected crop trees has reduced their potential value. The spruce plantation has suffered mostly from suppression from overwood. Logging damage further increased damage .

Can any future care be expected for these plantations? The present owner, Mr. Fransblau, has indicated that given the technical advice, he would consider improving his plantations. He has the men, the time, the money and the equipment. Mr. Raymond Pfiefer, Farm Forester, plans to study the pine plantations and make recommendations for improving them. He believes that the owner is progressive enough to care for the plantations, providing he is shown that it will pay.

SUMMARY AND CONCLUSIONS

In this study of problems of forest plantations in Lower Michigan, major emphasis has been placed on after-planting care. Problems are discussed as they relate to the development phases of growing plantations. Examples of plantations suffering from neglect of after-planting care are given, general observations having been made on the Huron National Forest and the Higgins Lake State Forest in Lower Michigan. The special problem on these forests is plantations in need of release cuttings. Further examples of plantation problems, these on private land, were discussed from the standpoint of plantations neglected in the more mature phases. Recommendations for improvements are suggested.

Forestry in the United States has reached the point where many forest plantations nearing maturity may soon be harvested. Time is ripe for inspecting past work with view to revising techniques or correcting faults in forest plantation practices. One problem well worth considering is the need for plantation after-care, both on private and government land.

Some time in the distant future, the state of Michigan may have on its hands a fair supply of good quality timber. This is possible if it cares for the plantations it has

already committed itself to establish. Failing to care for them, thousands of acres of plantations now being stymied in their growth will end up as part of a gigantic, wasted reforestation program.

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