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Reproduction Studies on the Minnesota National Forest

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The Minnesota National Forest presents some interesting and important problems in reproduction. The silvicultural system in practice is that of clear cutting, leaving scattering seed trees, and is prescribed by the Morris Act of 1902 and subsequent amendment of 1908. The original statute authorized the leaving of five per cent of the volume of pine on any specified area sold to a single purchaser. The trees left on the sale area are selected by the forest officer in charge. The amendment of 1908 increased the volume left in seed trees to ten per cent. The securing of reproduction and thus a second crop of timber on the forest is extremely important for it is probable that no other area in our national forests possesses greater possibilities of large financial returns. The two important species on the forest, white and Norway pines, can be grown on nearly all of the forest and much of the land should be classed as quality 1 site. Under such conditions both white and Norway pine have large possibilities.*

The great bulk of the virgin white and Norway pine stands on the forest has been logged. However, 10 sections reserved in the vicinity of Cass Lake afford good opportunities for a study of mature Norway and, to a limited extent, of white pine. Studies were made in both mature stands and on cut over areas.

NORWAY PINE STANDS

One of the heaviest pure stands of Norway pine on the Minnesota National Forest has been reserved on Star Island in Cass Lake. The trees have all reached maturity and range in age from 200 to 225 years. They are from 75 to 100 feet in height and have a large per cent of clear bole with short, flat, thin crowns. One typical sample acre has 60 trees—all mature Norway pine—which average in D. B. H. 13 inches, in total height 82 feet, and

*United States Department of Agriculture Bulletins, Numbers 18 and 139.



A good Norway pine seed tree surrounded by a dense ground cover. Reproduction is very scarce in such areas.

in clear bole 60 feet. The tallest tree of the plot is 92 feet and the largest diameter 16 inches. A second sample acre had 70 mature Norway pine and a third, 332. The average crown density in the type runs at about three-tenths.

The ground cover consists of a thick carpet of blue-berry, wintergreen, strawberries, ferns, hazel, dogwood, etc. A litter, chiefly of pine needles and from 1 to 3 inches in depth, covers the mineral soil which is a fine to medium sand with a small amount of silt and clay mixed in. A layer of humus about 1 inch thick intervenes. The moisture of the soil is abundant and sufficient for the germination of seeds in case they once reach the mineral soil.

A sample plot of one-fourth acre was examined in the Norway pine type and every tree to the smallest seedling was listed. On the area were 83 trees—all mature Norway pine—and a few saplings of paper birch, aspen, black oak and white pine. While there were no white pine of seed producing age on the plot, an occasional tree was noted at some distances from the sample area. A count of the seedlings gave the following result: White pine, 485; Norway pine, 350; paper birch, 38; oak, 32; aspen, 15; and red maple, 3. The pines range in height from 8 inches to 3 feet and from 5 to 10 years in age. Figured on a per acre basis would give 1,940 white pine, 1,400 Norway pine, and 440 hardwoods.

It is significant that while there were no white pine of seed producing age on the area, yet this species leads in the reproduction. The fact, however, that a few scattering white pines occur near the plot and that the mature stand is so dense, probably explains the prevalence of the more tolerant white pine seedlings over the less tolerant Norway. Perchance, a fire may have cleared the soil during a good seed year of white pine, although no record of such exists. Observation was made that the Norway pine seedlings occur in clumps where natural openings exist. This would substantiate the first of the above two theories.

A second sample plot of one-half acre was taken in a less dense stand. On it were found 35 mature red pines. The sample area borders a cut-over strip, thereby allowing additional light to reach the forest floor from the side. The reproduction on this area was found to consist of 860 Norway and 150 white

pine. In this plot the reproduction ranged up to 1 inch in diameter. The Norway seedlings were not only in the majority but they were more evenly distributed over the area, due no doubt to the openness of the stand and the larger amount of light admitted to the forest floor from the sides.

A third plot of one-fourth acre some distance from the first 2 contained 40 mature trees—again all mature Norway pine. A count of reproduction gave 254 Norway pine and 14 white pine seedlings, or figured on the acre basis 1,016 Norway and 56 white pine. The red pine again occurred in clumps in the openings. The small number of white pine seedlings was due to the absence of any seed trees of this species near the plot and also to the comparatively high ground on which the sample area was located.

A summary of the reproduction on the above plot follows:

Plot No.	Size of Plot	Seedlings on Plot			Seedlings per Acre			Total all Species per Acre
		White Pine	Norway Pine	Hard-woods	White Pine	Norway Pine	Hard-woods	
1	$\frac{1}{4}$ acre	485	350	88	1940	1400	440	3780
2	$\frac{1}{2}$ acre	150	860	.....	300	1720	.....	2020
3	$\frac{1}{4}$ acre	14	254	.....	56	1016	.....	1072

In a complete reconnaissance later over the entire Norway pine type the density and kind of reproduction was estimated at every chain's length along strips 5 chains apart. It was found that the reproduction varied in density from three-hundredths to three-tenths. An average density over the whole area is about fifteen-hundredths. Over a considerable portion the density is slightly less than two-tenths while on the remainder it is only about seven-hundredths. The proportion of the species in the reproduction likewise varies greatly. In some areas practically 100 per cent is Norway pine while in others the white pine is in the majority. A fair average in the pure Norway stand is about 75 per cent Norway and 25 per cent white pine.

An examination was made of a cut-over area which contained both Norway and jack pines, in order to determine the results of these species in competition on such situations. The results show the superiority of jack pine over Norway pine in reproducing itself. A plot of one-fourth acre was located in Section 15 just south of the town of Cass Lake. The area had been previously cut over leaving 5 per cent of the trees for seed



Openings in the mature stand are very often covered by good reproduction.

purposes. On the plot were 6 Norway and 7 jack pine seed trees and within 100 feet of the area were, in addition, 10 Norway and 5 jack pine. Thus, a total of 16 Norway and 12 jack pine were in position to seed the sample area. The mineral soil was exposed over most of the plot. Very little litter, humus or vegetation was present. The exposure was south with about 5 per cent gradient. The soil, consisting of a fine sand with a small amount of clay and silt, was rather dry. I should classify the area as Norway pine land with jack pine encroaching. A summary of the reproduction found on the quarter acre plot follows:

	Seedlings	Small Saplings	Large Saplings	Total
Jack pine	418	776	98	1292
Red pine	118	13	0	131
Red oak	1	21	2	24
Birch	0	1	4	5
Burr oak	0	3	0	3
Big tooth aspen..	0	1	0	1

The stand per acre on the above basis would be 5,168 jack pine, 524 Norway pine, and 132 hardwoods. The proportion of the Norway to jack pine reproduction is thus about 10 to 1. Not only was the jack more numerous but it is for the most part overtopping the slower growing Norway. These results, I believe, are typical of areas where red and jack pine are mixed. The large amount of seed produced nearly every year by jack pine gives it a decided advantage over Norway pine.

WHITE PINE STANDS

Little opportunity was offered around Cass Lake to study reproduction in the mature white pine. South of Cass Lake near Norway Beach is a limited amount of open white pine. Examination of the area indicated that the hardwoods were taking possession. On a one-fourth acre sample plot, containing 14 mature white pines, but few scattering white pine seedlings could be found. Hardwood reproduction of burr oak, red maple, paper birch, basswood, aspen, ironwood, etc., formed a dense undergrowth. The lack of pine reproduction may have been partially due to the fact that a fire had burned over the area but a few years previous.

On Star Island is located a mixed stand of pines and hardwoods which might properly be classed as a white pine situation.

Over-mature white and Norway pines remain as remnants of the original stand and hardwoods make up a very dense understory. The soil is a moist but well drained sandy loam. A thick layer of litter from 1 to 2 inches covers most of the area and little underbrush is present.

A sample plot of one-fourth acre was taken near the center of the type. The area contained 3 white and 3 Norway veterans and a dense understory of hardwoods. A count of seedlings gave the following: maple, 391; basswood, 12; ironwood, 4; burr oak, 3; birch, 3; white pine, 2; and Norway pine, 0.

Another count taken along the slope where the mineral soil was exposed and the stand less dense gave maple, 93; white pine, 55; birch, 4; red pine, 2; burr oak, 1; and aspen, 1; on a fourth of an acre.

These sample areas indicate that the hardwoods are crowding out the pines. Unless aided by fire at the time of cutting or by artificial reproduction it is doubtful if the pine will ever again constitute a majority of the stand.

Studies made on a cut-over area of white pine are interesting in showing results under the Morris Act, where 5 per cent of the seed trees have been left for reproduction. The original stand had been pure white pine with an average of about 100 trees per acre. Five sample plots of one-fourth acre each were taken on which were found an average of 8 seed trees per acre or 12½ per cent of the trees on these particular areas. Four of the plots taken represent more nearly average conditions while the fifth was located on a small area where an unusually large amount of seedlings was found. The cuttings on the area had occurred in 1905, 9 years previous to examination.

The ground cover over the entire area is very dense, consisting of shrubs, weeds and grasses. Most of the ground cover overtops the conifer seedlings by at least 2 feet. Beneath is a layer of litter and humus averaging about 2 inches thick. This layer is being added to from year to year by the deciduous ground cover. The mineral soil is very fine in texture and consists of a mixture of sand, clay and silt in order of abundance. The areas examined were moist but well-drained and are typical white pine land.

On 4 of the 5 sample areas examined the pine reproduction was negligible. On 1 of the 4 not a single pine seedling



A dense stand of pure Norway pine in which reproduction studies were made. Note the absence of pine reproduction and the amount of other vegetation.

occurred. An average of the four plots, each consisting of one-quarter acre, follows: white pine, $\frac{3}{4}$ of a seedling; Norway pine, $5\frac{3}{4}$; red maple, 68; aspen, 48; paper birch, 32; red oak, 31; burr oak, 14; balsam poplar, 4; willow, 3.

The fifth sample plot was taken because it was the only area in the whole region examined on which pine reproduction was found in anything like a stand. The mineral soil was exposed, there being no litter and a less dense cover of brush, weeds and grass than in other plots. Three white pines were standing and 22 had been logged. One healthy Norway pine stood about 150 feet from the plot. A count of the reproduction on this quarter acre gave white pine, 273; Norway pine, 461; aspen, 44; paper birch, 18; maple, 10; and burr oak, 8. In every direction from the plot, pine reproduction was extremely scarce. The Norway pine seedlings had undoubtedly come from seed blown from the 1 neighboring seed tree.

The above facts do not form a sufficient basis from which to draw definite conclusions regarding reproduction on the Minnesota National Forest. For definite conclusions more and better correlated data would be necessary. They do, however, give some positive indications.

They indicate, first, that natural reproduction of the two principal species has generally been very unsatisfactory. On cut-over areas the scattering seed trees have, as a rule, failed to establish a second crop, while the reproduction present before the logging has generally been destroyed by the operation. The failure to secure a good reproduction is apparently due to a combination of conditions. In the first place there is little possibility of the pine seed ever reaching the mineral soil, which it must do to germinate. In the mature stands the soil is covered with a layer of litter and a thick carpet of vegetation. Above this usually exists a growth of brush and weeds which is quickly and greatly increased when the mature trees are removed, until there is little chance of the seed ever reaching the mineral soil. Coupled with this condition is the fact that white and Norway pines are comparatively light seed bearers. Good seed years occur at intervals of from three to seven years, which places these species at a distinct disadvantage as compared with the more prolific seed producers. Several years may elapse between the logging and a good seed year, during which time the ground cover becomes

denser. Most of the virgin white and Norway pines are also past the age of vigorous seed production, which still further hinders their chance of production. These combined conditions have resulted for the most part in poor reproduction.

No doubt, where fire has burned over the area or the logging has occurred during a good seed year, reproduction has followed. These are the exceptions, however, and not the rule; for cutting has gone on under the Morris Act without regard to seed years. On the other hand, reproduction by jack pine and the hardwoods has occurred in profusion on those white and Norway pine lands which are near jack pine or hardwood seed trees. As a result, only the inferior species are reproducing naturally on the forest under the present system of silvicultural management.