D. Small Trees

1 – Distribution

2 – Composition

3 – Origin and ages

4. – Number of generations on each class

5. – Height growth

6 – Other Characteristics

D. Small trees

The small trees are an integral part of a forest stand and must be considered by any investigation which is concerned with the developmental trends of the forest vegetation. Surveys, techniques were employed to describe the distribution, composition, origin, age, and other gross characteristics of this forest component.

All trees, both alive and dead, ranging in age from less than 1 1/2 inches in diameter inside bark at 4 1/2 feet above the ground to the smallest recognizable seedling were arbitrarily classified as "small trees." This division was made solely to facilitate the description of the stand in general.

Distribution

By using the 10-foot grid (as a base) a map was constructed to the scale of 10 feet to an inch which

showed the location of every small tree on the area under investigation. Fig. (Appendix)

Each 10-foot quadrat formed by the grid was used as a mapping unit. Plotting equipment consisted of three Philadelphia-type leveling rods and standard 10 x 10 to 1 inch cross section paper. Starting in the southwestern corner of the grid, a rod was placed in a stationary horizontal position on the eastern side of quadrat 1-A. Another rod was placed in a similar position along its western side. A third rod was placed on the southern edge of the same quadrat so that it could be moved from south to north at right angles to the other rods. Fig. (M-D-1) By effect, the three rods formed a 0.1-foot grid which could be used to locate the small trees to within 1/10 of an inch on the ground. The locations could be plotted on the map to within 2-4 inches of accuracy.

Photo showing how small trees were plotted in 10-foot quadrat using 3 rods.

Fig. (M-D-1

Meth.

Most of the trees were assigned individual reference numbers. Sprout clumps were considered as one tree. Where several small seedlings were located within a space of a few square inches, one number was assigned to the group. The members of the group were then described individually. Occasionally, there was an abundance of current year's seedlings within a quadrat. If they were too numerous to locate and number either as individuals or groups, as a last resort they were counted by species and recorded as being present in the particular quadrat where they occurred.

The quadrats were mapped one tier at a time, beginning with the tier along the western boundary of the research area and proceeding to the eastern boundary. There were _____ small trees present on the entire area. Of these, _____ were assigned individual numbers. The rest were either assigned group numbers or were too numerous to locate and number individually.

Composition:

As the small trees were located and mapped, the species, height, and diameter of each were recorded. Table (Appendix) The diameters were measured at the base of the stems to the nearest 1/16 of an inch. Heights were measured to the nearest inch. Multiple stemmed-sprout clumps were considered as one tree, however the number of individual sprouts on each clump was recorded, as were the ranges in diameters and heights of the stems.

Origins and ages:

The origin of the small trees were decided into four classes: seedlings, seedling sprouts, stump sprouts, and root suckers. Those trees of sprout origin which originate from a parental clone less than

1 1/2 inches in diameter at the base were arbitrarily considered as seedling sprouts. If the sprouts originated from a parental element which was 1 1/2 inches or larger in diameter at the base, they were designated as stump sprouts. Sprouts arising definitely from roots rather than from stumps were classed as root suckers. All other small trees were regarded as seedlings.

The origin and ages of the small coniferous trees were easily determined. White pine and hemlock were the only conifers represented on the area of investigation. Since vegetative reproduction does not generally occur in white pine and hemlock, all small trees of these species were designated as of seedling origin. Their ages were determined by removing cross-sections from their bases immediately above the root collars. Fig (M-D-2)

Vegetative reproduction by sprouting is very common among the broad-

Photo showing cross-section which was removed from coniferous seedling to determine age.

Fig. (M-D-2)

combine

Photo showing how ages of two cross-sections removed from a tree of seedling origin are the same.

Fig. (M-D-3)

leaf trees of this region. Thereupon it immediately became apparent that the only way to determine the real origin and the true ages of many of the small broadleaf trees was to compare the ages of their boles with the ages of their roots. If two cross-sections are removed from a tree of seedling origin, one from directly below the root collar and one from immediately above the root collar, the age of each will be the same. Fig. (M-D-3) When the same means of determining ages is applied to a tree of sprout origin, it is commonly observed that the root is older than the bole. Fig. (M-D-4) A similar age relationship is often found to exist between some of the roots and boles of a tuft of stump sprouts of origin; the roots are older than the boles. Fig. (M-D-5)

The differential in ages of the roots and boles of sprout-origin hardwoods would appear to be re-

Photo showing how ages of two cross-sections removed from a tree of seedling sprout origin are different - the root being older.

(M-D-4) - Cross-sect of a white oak seedling root. Larger of 2 sections is root - age 59 years. Smaller is of stem - age 11 years. One inch cross-section paper is scale.

Same as above, only tree of stump sprout origin used.

(put in section D here showing 4 generations)

Fig (M-D-5)

lated to several factors. In the final analysis, the differentials in ages is due primarily to the relationships which are developed over time between the sprouts and their parental clones. More specifically, the degree to which the root system of the original parental element becomes involved as an active participant in the physiological processes of the sprouts.

The physiological relationships between the roots and aerial parts of a tree of sprouting origin is very intimate and began with the germination of the seed from which the tree grew. The oldest part of the root system is the same age as the oldest portion of the bole. If the bole of a hardwood tree of sprouting origin is cut down, broken off, or in some way killed back to the region of the root collar, one or more sprouts will usually develop from the remaining live stump. The physiological relationships which will in turn develope between the new sprouts and the old root system

seems to depend to a large extent upon the diameter and age of the parental stump. Observations indicate that the smaller the parental stump the greater is the probability that the already existing root system will be carried over and become a part of the new generation of sprouts. The diameter of the parental stump has been used indirectly as a criterion of the relationships between the roots and bole of sprout hardwoods. Louis J. Lefflman and Ralph C. Hawley in their connecticut hardwoods, designated 2 inches as the maximum diameter of the parental stump from which sprouts could be expected to use the entire root system of the previous generation. When the stump was over 2 inches in diameter, the sprouts formed an independent root system, but might incorporate a portion of the old root system into its own. (Lefflman and Hawley, 1925) This root and bole relationship of sprout hardwoods can also be influenced by factors other than the diameter of the

parental stumps. Nevertheless, the relationship is manifested in the differences in ages which usually exist between the oldest parts of the root systems and ~~the~~ boles of sprout hardwoods.

Since the differential in ages between the roots and boles of the small trees was to be used as a criterion of origin, it would be necessary to obtain cross-sections from the oldest portions of both the roots and boles. This meant that large parts of each root system of every small hardwood tree would have to be excavated. In order to diminish the amounts of labor and time involved in such an undertaking, external features of appearance were employed to differentiate the small broadleaf trees ~~of~~ according to origin from seed of sprout origin. As a result, no root excavating would be required for the seedlings, and only one cross-section would have to be taken from the bole of each for age determinations. In no instance, however, could the true age of a sprout hardwood be determined with certainty from only one

cross-section, unless it was removed from the oldest part of the root system, and then there would be no sure way of checking on the tree's origin. Besides, the ages of the current sprouts could conceivably be as important as the total ages of the clones. Therefore, two cross-sections were removed from every small hardwood tree of sprout origin and from every one of doubtful origin. The sections could then be taken to the laboratory, and the ages and origins of the trees could be determined.

In actual practice, the field work associated with the origin and age aspects of the small trees was quite simple. Stump sprouts were easily determined. Invariably the remnants of the parental elements were still apparent. Since in general, only small trees and stumps were being dealt with at this particular stage of the investigation, the whole stump sprout clump was excavated whenever

possible with the short stubs of roots and holes intact. Fig. (M-D-6)
Occasionally, small sprouts were observed growing from very deteriorated stumps. In these instances, roots were quite often not available. As a result, sections of the old rotten stumps were collected along with the hole sections. Every effort was made to collect specimens which might possibly extend the dates of origin of the clones further into the past.

Seedling sprouts were more difficult to recognize. They could be confused with seedling-origin trees. Here again, the table was made much easier since small trees were being dealt with at this time. Not only were they quite readily excavated, but the trees were small enough to have retained many of the characteristics which are associated with origin.

Trees of seedling origin tended to have only one hole, while seedling sprouts were apt to have one or more. Number of holes could not be used as a definite criterion of origin, but the presence of more than one hole had the tendency to alert one to the possibilities of seedling

Fig. M-D-6

Red maple of stump sprout origin. Largest bole was dead-age 54 years. Smaller sprouts alive — ages 11 years. Oldest roots too decayed for age determinations. Young roots — 11 years of age.

sprout origin. In many instances, even before elevation, the remnants of the small parental elements of the seedling sprouts were still apparent. Even these remnants, however, could not be used as conclusive evidence of origin. Such evidence could be sought by the digging back of one or more holes of a multiple stemmed, seedling origin tree.

Elevation exposed some very pronounced differences between the trees of seedling and seedling sprout origin. Fig. (M-D-7) and Fig. (M-D-8) the roots of small seedling sprouts were greatly out of proportion when compared to the size of their aerial parts. The roots were much longer in diameter and often longer than the boles. A small seedling origin tree with a bole which might have been the same age and size as that of a seedling sprout had a strikingly different appearance. Its root system was nearer the same proportions as its aerial parts. This size relationship between roots and boles appeared to be a good criterion of origin. If the tree species concerned in this particular investigations, the feature was most pro-

marked in the red and white oaks. As a characteristic of origin, its value would diminish with the increased age of the trees.

The parts of the small trees which are usually associated with the regions of the root collars provided another means of separating seedling from seedling sprout origins. The root collar region of a small seedling origin tree was characterized by a smooth, slight curve. The same region of a small tree of seedling sprout origin was characterized by an abrupt curving at the point of union of the sprout and its main root approached a 90 degree angle. This feature was most pronounced in the small red and white oak trees. Its value as a characteristic of origin would also diminish with time.

Another feature of the root collar could be used to differentiate small trees of seedling and seedling sprout origin. The root collars of seedling sprouts often showed evidence of healed-over bole scars. The scars occasionally imparted a lumpy appearance to the root collars.

North.

Small trees of root sucker origin were readily distinguished. Root sucking as a means of vegetative reproduction occurred most commonly in beech and chestnut. Fig. (M-D-9) The sucker usually joined the parental root at an abrupt angle, almost vertically in many instances. The main root could often be traced to its parental stump. It was also observed that occasionally the main root on the side of the sprout which led to the parental tree was smaller in diameter than the one on the opposite side. The difference in diameters of the root on each side of the sprout was so marked at times that it suggested that the direct union between parent and sprout was eventually disrupted.

The actual practice of handling the small trees in the field varied with the origin and size of the trees. Small trees of seedling origin less than one foot tall were excavated intact, numbered, described, and taken to the laboratory where a section was removed from the base of each stem. Small trees of seedling origin but taller than one foot

Fig. (N-D-9)

Beech root suckers.

were handled in similar manner except they were obtained in the field. The sections were removed from the bases of the holes, numbered, and taken to the laboratory for age determination. Small trees of seedling sprout origin were excavated, described, and their holes and roots were removed leaving stubs several inches long. The stumps with stubs intact were then numbered and taken to the laboratory where sections were removed from the bases of the holes and roots. The small trees of stump sprout and root sucker origin were handled in a manner similar to the seedling sprouts. A general practice was made of removing two cross-sections from each tree of unknown origin, either in the field or in the laboratory.

The process of determining the ages and origin of the trees which were less than 1 1/2 inches in diameter

inside bark at 4½ feet above the ground included ——— individual crass-sections of the holes and roots. Fig. (Appendix)

Number of generations on each clone:

An attempt was made in the field to determine the number of generations of sprouts that had grown from each of the parental clones. A difference in ages between the holes and roots of a sprout origin tree would indicate that at least one generation of sprouts had grown from the parental stumps, but the specific number would not be denoted. Other characters, external features of the clones were observed to ascertain the number of generations.

In most instances when small or young sprouts were being observed, remnants of the preceding generations were still apparent. The remnants were commonly in the forms of stumps of cut and broken holes, or the entire dead

all of which were
holes, and various stages of decomposition.
Any comparative approach must be
employed when these remnants are to
be used as criteria of the number of
generations of sprouts that any particular
clone has supported in the past. All
of the holes of a multiple sprout clump
whether they are present as entire
broken tubes, as dead trees, or as
live regrowth trees could be members
of the same generation of sprouts.
Observations indicate that regardless of
the number of stems per stump at the
beginning of a new generation of sprouts,
the number decreases with age
until at the end of a 60 to 70-
year rotation the sprout clumps
would in general be composed of from
2 to 5 stems. (Cline and Lokkard,
1925) This is particularly characteristic
of sprouts from stumps which are
6-12 inches in diameter. However,
even where starting with small
stumps, the tendency for the number of
sprouts to decrease with age must
be considered. Therefore, the remains

of past and present sprouts were approached with caution.

In other instances, the numbers of generations of sprouts represented by the stems were quite obvious. This was particularly true when the bole or butts of trees of either seedling, seedling sprout, or stump sprout origin had been cut or killed back in some manner to a point above the root collar region. Fig. (M-D-10) and Fig. (M-D-11) In such cases, the number of times these boles had been damaged was recorded.

In every case where the number of generations could not be determined with certainty, an estimate of the minimum number was recorded.

Height growth:

The height growth rates of 72 small trees were determined. Seven different species were included. The growth rates were determined from the ages of cross-

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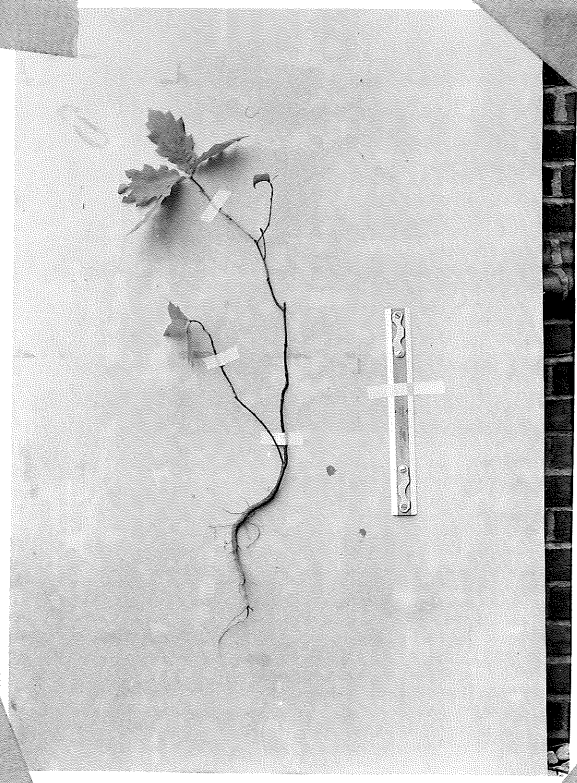

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Fi -D-10)

How many times broken off?

Fig. (M-D-11) - Black oak stump sprouts. The original tree was cut down in 1938. The first generation of sprouts is 14 years old and was cut back in 1944 to a height of 4 feet. The second

(over)

generation of sprouts is 8 years old,

sections which were removed from the holes at intervals of one foot. Fig. (M-D-12)

Other gross characteristics:

Other gross features of the small trees were recorded in the field. As the trees were excavated, an attempt was made to describe the general juvenile forms of their root systems. Three forms were recognized. The two extremes in form were represented by root systems composed primarily of a large taproot, and those which tended to be mat-like and of many small fibrous roots. Between these intermediate forms were also recognized. Fig. (M-D-13), Fig (M-D-14), Fig. (M-D-15)

As the small trees were being located and mapped, their relative situations on the forest floor were observed. That is, whether they were growing on

Photo of cross-sections removed from bites of small trees at 1 foot intervals.

Fig. (M-D-12)

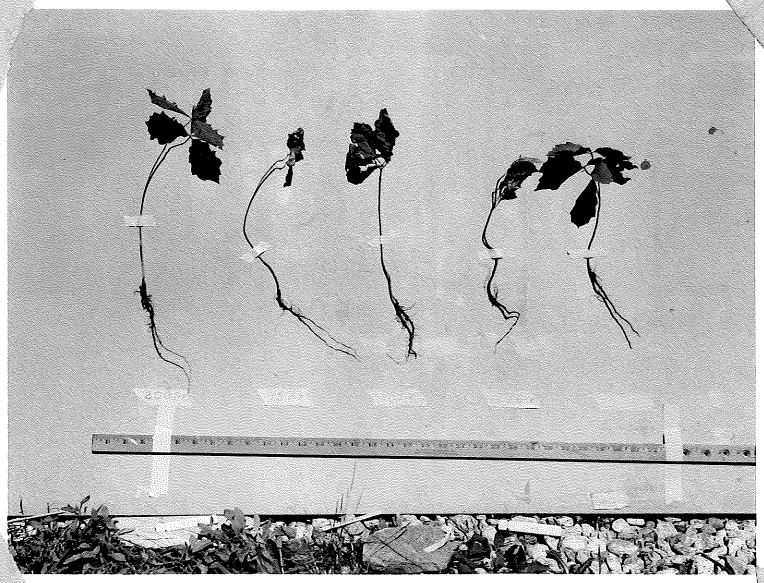
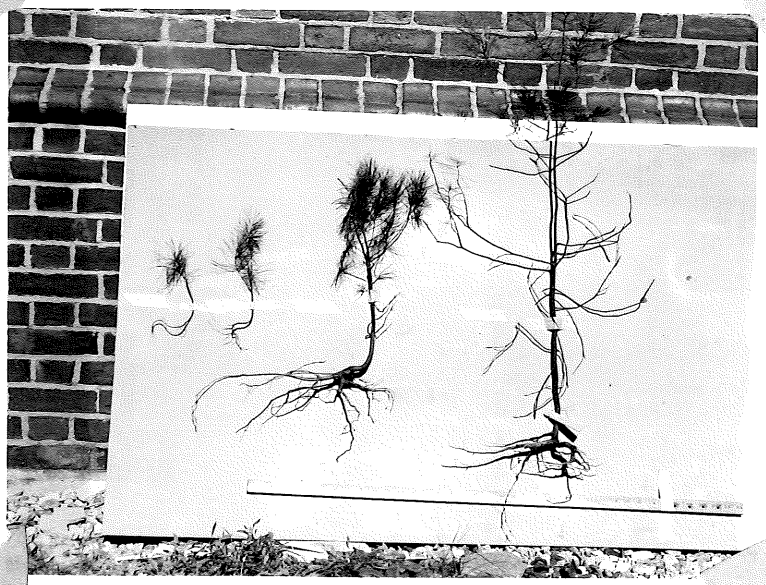


Fig. (M-D-13)
Red oak seedlings. Root system with definite taproot.

Fig. (M-D-14)
White pine seedlings. Root system composed of several large roots.



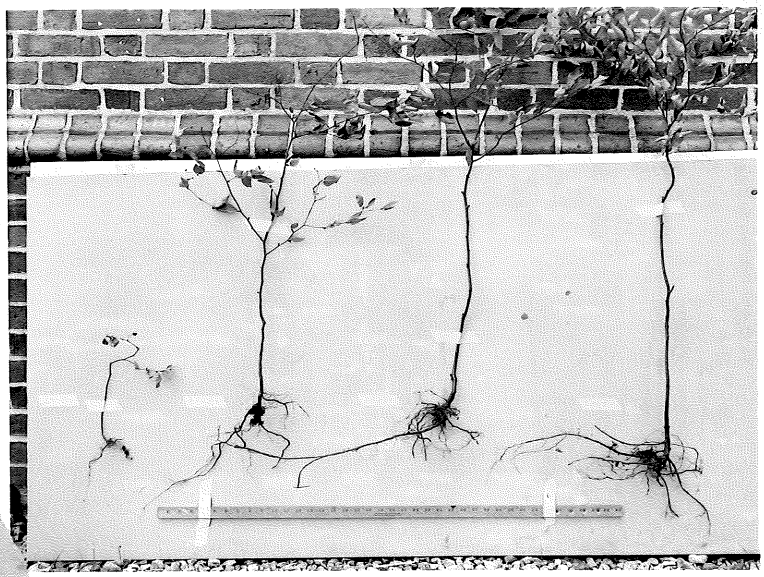


Fig. (M-D-15)
Black birch seedlings. Root system tends to be mat-like with many small-roots. Roots have grown in shape of log on which they were growing.

tops of stumps, on prostrate tree boles, boulders, mounds, in pits, or on the forest floor proper. It had been observed that many of the larger trees of the research area were growing in positions other than on the immediate ground level. Therefore, it was deemed advisable to ascertain the relative positions of the small trees. The extremes of situation could be defined quite readily. However, it was soon experienced that the particles of bark and limbs, the stones, small expanses of relief, crevices between boulders, deposits of mineral soil, small animal burrows, and moss beds where the small trees were growing defied description. Nevertheless, the depth was recorded, while the positions were recorded, while the coincidences between general situations of the small trees and the various components of the forest floor were left to be exposed by a series of maps which was to be constructed at a later stage of the investigation.

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The field work which involved the general description of the small trees on the entire research area required ——— man days. During this time one man worked alone for ——— days and this was helped by two assistants for ——— days.