TRELEASE WOODS, CHAMPAIGN COUNTY, ILLINOIS: WOODY VEGETATION AND STAND COMPOSITION

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ABSTRACT. — An inventory of the woody vegetation of Trelease Woods northeast of Urbana, Champaign County, Illinois shows that the present stand is composed of 149 stems per acre (3" and above in diameter) with a basal area of 93 square feet. Thirty-seven woody species were tallied with sugar maple being the leading dominant. Hackberry, white ash, slippery elm, basswood, red oak, and buckeye followed in order of Importance Value Index. The large number of dead elm is the most striking feature of the present stand. Total mortality, as indicated by dead-standing and dead-down trees, amounted to 51.5 square feet of basal area per acre; 45 square feet was elm. A heavy understory, dominated by sugar maple and pawpaw, has developed. Almost half of the trees less than one-inch in diameter are sugar maple, and this species appears likely to increase its dominance in the future.

Trelease Woods (formerly known as University Woods) is a 60-acre remnant of the "Big Grove" that once occupied a 10-square-mile area in a bend of the Salt Fork River near Urbana, Illinois. Such forested areas, usually isolated from the main bodies of timber that occurred chiefly along watercourses, were known as "Prairie Groves." They were believed to have been cut off from larger forested areas by attrition from repeated fires and were usually found protected by streams, sloughs, or rough morainal lands.

Trelease Woods was acquired by the University of Illinois in 1917 and has since been maintained as a natural area for research and educational purposes. It has been classified as mixed-mesophytic in composition and probably has developed on uplands that were occupied by prairie grasslands 400 to 600 years ago (Vestal and Heermans, 1945). The first complete inventory of the woody vegetation of this woodland was completed in 1963, and the results are presented in this paper. Results of a similiar study in Brownfield Woods, another remnant of the Big Grove located about one mile to the west, have been reported previously (Boggess and Bailey, 1964). Terminology used throughout the text is that of Gleason (1963).

PAST WORK

McDougall (1922) made a stem count of the trees and listed the other woody and herbaceous species that occurred in the woodland. His list of species included 31 trees, 12 shrubs, 6 lianas, 134 herbs, and 5 ferns. The number of trees were as follows: *Acer saccharum*, 1,987; *Ulmus americana*, 2,073; *Fraxinus americana*, 537; *Tilia americana*, 321; *Carpinus caroliniana*, 303; and all other species, "less than 300 individuals." Maple was more dominant in the south half, and elm in the north half of the woodland. The general position of these two species, as they occurred in 100 x 100-foot blocks, was also shown on a map of the area. Dominant shrubs were pawpaw (*Asimina triloba*), spicebush (*Lindera benzoin*), and hawthorn (*Crataegus spp.*).

McDougall and Penfound (1928) cited the above paper but gave somewhat different figures for the number of trees and species in the woodland. They listed a total of 7,147 trees comprised of 28 species compared with approximately 5,847 trees and 31 species in the earlier report. That they were quoting from the same data is evidenced by identical figures for the number of American elm, sugar maple, and white ash.

Weese (1924) commented that the woodland had been rather heavily grazed prior to its acquisition by the University and that some trees, particulary black walnut (*Juglans nigra*), had been cut as evidenced by stumps remaining at that time. After five years of protection, however, hardwood species were reproducing in considerable numbers.

Vestal and Heermans (1945), in a study of plot size requirements, reported the number of trees and basal area per acre (trees 3 inches and above, d. b. h.) for the 12 leading species. This was based on data collected between 1935 and 1940 from a 14.4-acre sample. The sample consisted of 10 of 12 plots, 0.8 acre in size, used by Heermans (1941) and a 6.4-acre block in the south half of the woodland, established in 1935, to study the relationships between the size, shape, and distribution of plots and estimates of stand composition (Marberry, 1936; Marberry et al., 1936). The two additional plots in Heermans' study (1941) were included in this block. Thus, it appears that the data of Vestal and Heermans (1945) were biased toward the south half of the woodland.

Numerous studies involving animal populations and ecology have been reported, but most of them are not pertinent to this study. Twomey (1945), however, delineated the areas of "red-oak—maple climax" and "elm sub-climax" as a part of his study of bird populations. He pointed out that although the woodland had been heavily grazed prior to 1918, the woody vegetation had come back to a normal condition after some 20 years of protection.

Methods of Study

All woody plants, 2.6 inches and above in diameter, were measured to the nearest 1/10 inch and tallied by species. Dead-standing and dead-down trees were also measured and identified when possible. Records were kept separately for each of the 96, 50-meter square blocks (0.619 acre) into which the area had been divided for a number of years.

Four sets of nested, circular quadrats, 1/100 and 1/1000 acre in size, were randomly located in each block. The 1- and 2-inch diameter classes were tallied on the larger, and seedlings on the smaller plots. The latter were separated into those less than 1 foot in height and those over 1 foot high but less than 0.6 inch in diameter. For convenience the stock and stand data for the entire woodland are presented on per-acre basis.

Description of Area

Trelease Woods is located in the SW¼ of Section 1, Township 19N, Range 9E, Champaign County, Illinois (40° 09′ N. Lat., 88° 10′ W. Long.). Topography is at the most gently rolling with a maximum difference in elevation of about 16 feet. There are numerous low areas where water stands during wet periods and are moist even in the dry parts of the year. The Woodland is surrounded by open land and has the usual edge vegetation of briars and low shrubs.

A detailed soil survey has not been made, but two main groups are present. These are (1) soils that are transitional between Brunizems and Gray-Brown Podzolic soils, and (2) Brunizem-like soils. The latter group is most prevalent, and the transition soils are minimal in development (Bailey et al., 1964). These soils have all developed shallow loess (3 feet or less) and calcareous glacial till of Wisconsin age.

A detailed description of a transition soil in Trelease Woods, identified as Toronto silt loam, has been given by Bailey et al. (1964). Some of its characteristics are shown in Table 1.

TABLE 1.—Characteristics of Toronto Silt Loam, Trelease Woods.

Horizon	Depth, inches	Sand, %	Silt, %	Clay, %	pH	Organic carbon, %	Cation exchange capacity, meq.	Base saturation %
A1	0-8	3.6	73.0	23.4	6.5	3.83	28.9	92
A21	8-14	3.7	72.2	24.1	5.9	1.92	20.6	80
A22	14-18	3.8	75.3	28.5	5.5	1.56	22.8	77
B1	18-22	4.0	64.2	31.8	5.2	1.36	24.2	76
B21	22-29	4.9	61.6	33.5	5.0	1.20	25.6	72
B22	29-36	13.7	57.4	28.9	5.1	1.22	21.7	75
II B3	36-45	22.4	53.8	23.8	5.8	1.06	16.6	91
II C	45-51	39.2	44.5	16.3	8.1	....	....	Calcareous

The fertility status of this soil is quite favorable as indicated by the cation exchange capacity and base saturation. The profile, however, is imperfectly drained and probably represents the upper level of internal drainage on the area. Poor drainage has undoubtably affected the height growth of trees and has limited the effects of forest vegetation in modifying this soil that was once occupied by grasslands.

RESULTS AND DISCUSSION

Three broad cover types have been recognized on the area (Fig. 1). These are (1) sugar maple, where this species makes up at least 50 percent of the stand; (2) mixed hardwood, in which no single species is dominant; and (3) dead elm. The latter were formerly pure elm and are now in a relatively early stage of succession following death of this species. Areas occupied by each type are about 30, 45, and 25 percent, respectively, for sugar maple, mixed hardwood, and dead elm.

The species encountered, with their density and frequency by size class, are shown in Table 2. The species symbol will be used to identify species in subsequent tables and figures. An additional breakdown into broad diameter classes, by number of trees and basal area per acre for the 13 leading species, is shown in Table 3. Also given are percent

Table 2.—Density Per Acre and Frequency of Woody Species by Height or Diameter Class. The species symbol will be used to identify species in subsequent tables and figures.

Scientific name	Common name	Symbol	Height class: Density, <1′	Height class: Density, >1′ <0.6″ diam.	Height class: Density, Total	Height class: Frequency, %	Diameter class: Density, 1″ & 2″	Diameter class: Frequency, %	Diameter class: Density, 3″+	Diameter class: Frequency, %
Acer saccharum	Sugar maple	SM	1276	1174	2450	52	114	41	37.81	96
Fraxinus americana	White ash	WA	151	36	187	6	8	4	10.38	96
Quercus rubra	Red oak	RO	188	34	222	13	0.3	0.3	2.81	70
Celtis occidentalis	Hackberry	H	255	115	370	16	32	18	20.90	96
Tilia americana	Linden, basswood	L	13	3	16	1	23	9	11.99	85
Quercus macrocarpa	Bur oak	BO	55	36	91	7	2	2	1.61	47
Juglans nigra	Black walnut	BW	....	21	21	2	7	4	3.96	70
Aesculus glabra	Buckeye	B	96	42	138	6	24	16	7.86	92
Ulmus rubra	Slippery elm	SE	70	55	125	6	44	17	17.96	96
Fraxinus quadrangulata	Blue ash	BA	29	52	81	4	11	8	2.86	66
Quercus Muhlenbergii	Chinquapin oak	CO	89	31	120	8	....	....	0.40	19
Gymnocladus dioica	Ky. coffee tree	CT	....	5	5	0.5	3	2	1.41	30
Ulmus americana	American elm	AE	5	8	13	1	8	4	4.16	56
Plata nus occidentalis	Sycamore	S	....	....	....	....	....	....	0.13	7
Carya ovata	Shagbark hickory	SH	3	5	8	1	0.5	0.5	1.01	20
Gleditsia triacanthos	Honey locust	HL	....	5	5	0.5	7	4	0.38	10
Carya cordiformis	Bitternut hickory	BH	23	26	49	3	3	2	0.52	24
Acer saccharinum	Silver maple	SiM	....	....	....	....	....	....	0.14	1
Fraxinus pennsylvanica	Green ash	GA	16	26	42	3	5	3	0.19	3
Morus rubra	Mulberry	M	3	....	3	0.3	1	0.8	0.38	12
Prunus serotina	Black cherry	BC	....	10	10	0.5	0.5	0.5	0.09	4
Quercus imbricaria	Shingle oak	SO	....	....	....	....	....	....	0.02	1
Crataegus mollis	Hawthorn	HT	3	3	6	0.5	8	4	6.71	58
Asimina triloba	Pawpaw	PP	112	570	682	31	480	55	9.08	55
Carpinus caroliniana	Blue beech	BB	23	5	28	1	11	6	5.67	67
Maclura pomifera	Osage orange	OO	....	....	....	....	....	....	0.12	3
Prunus americana	Plum	P	....	....	....	....	....	....	0.13	1

Prunus virginiana	Choke cherry	CC	3	3	6	0.5	24	16	0.07	10
Cercis canadensis	Red bud	RB	3	....	3	0.3	0.5	0.3	0.08	5
Lindera benzoin	Spice-bush	SB	608	94	702	16	89	18	0.03	2
Cornus racemosa	Gray dogwood	GD	3	....	3	0.3	2	1	0.02	2
Euonymus atropurpureus	Wahoo	W	23	8	31	2	....	....	....	....
Staphylea trifolia	Bladder-nut	BN	10	8	18	1	3	0.3	....	....
Zanthoxylum americanum	Prickly ash	PA	52	128	180	2	....	....	....	....
Viburnum lentago	Nannyberry	NB	5	3	8	1	1	0.3	....	....
Sambucus canadensis	Elder	E	16	5	21	1	0.5	0.5	....	....
Corylus americana	Hazelnut	HN	42	23	65	2	....	....	....	....
Total	....	....	3175	2534	5709	....	912.3	....	148.88	....

TABLE 3.—Number of Trees, Basal Area Per Acre, Importance Value Index, and Average Diameter for Leading Dominants.

Species	3-6		7-12		13-24		25-26		37+		Total		Percent Total		Impor. Value Index	Av. diam., in.
	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.	No.	B.A.		
SM	16.26	1.31	10.15	5.17	10.49	16.80	0.84	3.62	0.07	0.59	37.81	27.49	25.39	29.52	54.91	11.5
WA	3.90	0.37	1.30	0.60	4.65	8.88	0.53	2.16	......	......	10.38	12.01	6.97	12.90	19.87	14.3
RO	0.11	0.01	0.03	0.01	0.91	2.10	1.66	8.31	0.10	0.80	2.81	11.23	1.89	12.07	13.96	27.1
H	14.45	1.49	4.73	1.89	1.07	1.79	0.59	2.74	0.06	0.56	20.90	8.47	14.03	9.10	23.13	8.6
L	7.90	0.69	2.12	0.95	1.64	2.83	0.33	1.54	......	......	11.99	6.01	8.05	6.46	14.51	9.6
BO	0.18	0.01	0.13	0.07	0.62	1.17	0.62	3.10	0.06	0.66	1.61	5.01	1.08	5.38	6.46	23.9
BW	2.09	0.25	0.13	0.07	1.27	2.57	0.47	2.04	......	......	3.96	4.93	2.66	5.30	7.96	15.1
B	4.79	0.38	0.96	0.48	2.04	3.46	0.07	0.28	......	......	7.86	4.60	5.28	4.94	10.22	10.4
SE	16.19	1.40	1.16	0.43	0.55	0.96	0.06	0.25	......	......	17.96	3.04	12.06	3.27	15.33	5.5
BA	1.06	0.10	0.79	0.36	0.91	1.59	0.10	0.51	......	......	2.86	2.56	1.92	2.75	4.67	12.8
CO	......	......	0.03	0.02	0.22	0.43	0.11	0.57	0.04	0.36	0.40	1.38	0.27	1.43	1.70	25.1
CT	0.82	0.08	0.23	0.11	0.34	0.65	0.02	0.08	......	......	1.41	0.92	0.95	0.99	1.94	10.9
AE	3.62	0.32	0.45	0.16	0.05	0.06	0.04	0.22	......	......	4.16	0.76	2.79	0.82	3.61	5.8
Others	22.58	1.69	1.11	0.43	0.80	1.32	0.24	0.88	0.04	0.37	24.77	4.69	16.66	5.07	21.73	5.9
Total	93.95	8.10	23.32	10.75	25.56	44.61	5.68	26.30	0.37	3.34	148.88	93.10	100.00	100.00	200.00	......

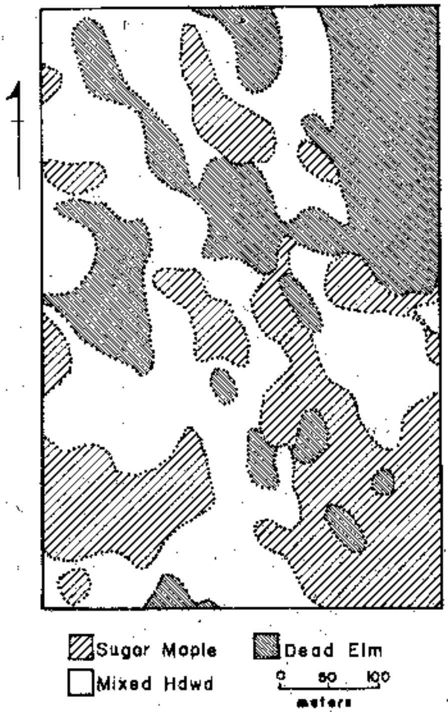

FIGURE 1. — Map Showing Broad Cover Types.

total number of trees, percent total basal area, Importance Value Index (IVI) and average diameter. Importance Value Index is a modification of the original IVI described by Curtis and McIntosh (1951), and used later by McIntosh (1957). It is the sum of the relative density

$$\left(\frac{\text{number individuals of species}}{\text{number individuals of all species}} \times 100\right)$$

and of the relative dominance

$$\left(\frac{\text{basal area of species}}{\text{total basal area all species}} \times 100\right).$$

IVI was determined for the 13 leading species on each of the 96 blocks and for the woodland as a whole.

Present stand composition, as illustrated in Figure 2, shows the number of trees per acre and the average basal area per tree for the 13 leading species, and for all other species combined. In such composition diagrams, the basal area per acre is represented by the area included in each bar of the graph (Vestal, 1953). A further representation of stand structure is shown in Figure 3, where total basal area and the amount of basal area in five

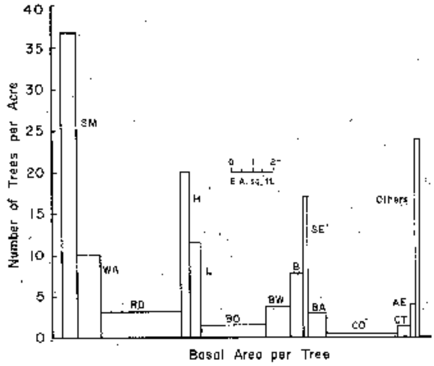

FIGURE 2. — Number of Trees Per Acre and Average Basal Area Per Tree.

(See Table 2 for explanation of species symbol.)

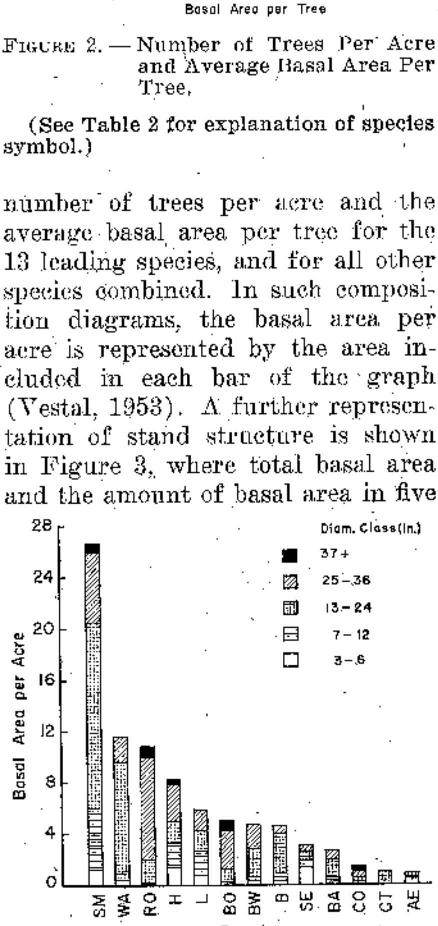

FIGURE 3. — Basal Area Per Acre by Species and Diameter Class.

broad diameter classes are shown for the various species.

Sugar maple is the leading species in the woodland, comprising one-fourth of the total number of trees and slightly less than one-third of the stand basal area. It is well represented throughout the stand with frequencies ranging from 41 percent for the 1- and 2-inch diameter classes to 96 percent for the larger trees. The high frequency of the latter is probably related to the relatively large block size (0.619 acre) used in the survey. The density of maple varied considerably throughout the woodland. On plots where is occurs, the IVI (which combined both relative density and relative basal area) ranged from 1 to 149 (maximum possible value, 200) with an average of 54.91. This value was more than twice as great as the value for the nearest competitor.

Hackberry ranks second in importance and is particularly prevalent in the 3- to 6-inch diameter class. Here it almost equals sugar maple in the number of trees per acre. It also has a frequency of 96 percent. Although there are a number of large hackberry scattered throughout the stand, the average diameter of 8.6 inches reflects the preponderance of small trees. These are fairly well distributed throughout the woodland.

The importance of the oaks is chiefly due to the large size of individual trees. Average diameters are 23.9, 25.1, and 27.1 inches, respectively, for bur oak, chinquapin oak, and red oak. The largest tree in the woodland is a 48-inch bur oak.

White ash and basswood, ranking third and fifth in Importance Value, are well distributed throughout the stand with frequencies of 96 and 85 percent. White ash has an average diameter of 14.3 inches compared with 9.6 inches for basswood. Basswood, however, is better represented in the smaller diameter classes but is reproducing very poorly compared to white ash.

Slippery elm, although ranking fourth in Importance Value, is largely present among the smaller diameter classes. It equals maple in the number of trees present in the 3- to 6-inch class and is well distributed throughout the stand.

The relative importance of the seven leading species can be illustrated by considering the number of blocks on which each species was the leading dominant (highest IVI), or ranked second, third, and fourth or less in Importance Value (Table 4).

Table 4.—Importance Value Index, by Numbers of Blocks for Seven Leading Species.

Species	IVI rank			
	1st	2nd	3rd	4th and below
	Number of blocks			
SM	55	17	6	14
H	15	15	11	52
WA	6	21	20	45
SE	3	7	18	63
L	7	9	7	59
RO	3	15	8	41
B	2	3	7	76

The relatively dense understory is dominated by pawpaw and spicebush, along with saplings of the various trees species. Pawpaw grows to a larger size than spice-bush, and its 480 stems per acre in the 1- and 2-inch diameter classes are almost as many as all other species combined. It also occurred on 55 percent of the 384 1/100-acre quadrats. Reproduction of both pawpaw and spice-bush is relatively heavy (682 and 702 per acre) and is exceeded only by sugar maple.

While the herbaceous plants were not included in this study, observations have shown that the early spring flora is dominated by trillium (*Trillium recurvatum*), Dutchman's breeches (*Dicentra cucullaria*), wild geranium (*Geranium maculatum*), blue phlox (*Phlox divaricata*), while wild ginger (*Asarum canadense*), water-leaf (*Hydrophylum spp.*), and May apple (*Podophyllum peltatum*) appear later. The summer season is characterized by the obnoxious woods nettle (*Laportea canadensis*) with some touch-me-nots (*Impatiens pallida* and *I. biflora*). The tall bell-flower (*Campanula americana*), along with white snake-root (*Eupatorium rugosum*) and various other Compositae, are most prominent in the late summer and fall.

Changes in Composition

The large number of dead elm is the most striking feature of the present stand and has resulted in significant changes in stand composition. This catastrophic mortality, amounting to 1,585 trees in the entire woodland, began about 15 years ago. It resulted from the combined effects of phloem necrosis and the Dutch elm disease. The number of dead trees per acre for all species combined and for elm are shown in Table 5.

Total mortality of all species other than elm was less than 5 trees per acre. Since both dead-standing and dead-down trees were tallied, the period covered by the mortality figures is probably 10 to 15 years. The magnitude of the mortality is emphasized by the fact that there is more than half as much area in dead trees as in living trees. All this has happened in a woodland that was completely protected from fire and grazing and that had a minimum amount of use and disturbance by man for a period of 45 years.

The proportion of sugar maple to elm appeared to change between

TABLE 5.—Mortality of Elm and all Species Combined.

	Diameter class, inches											
	3-6		6-12		12-24		24-36		36+		Total	
	All	Elm	All	Elm	All	Elm	All	Elm	All	Elm	All	Elm
Number of trees per acre..	7.8	6.8	6.9	5.8	12.7	10.8	4.3	3.8	0.4	0.4	32.1	27.6
Basal area, sq. ft. per acre.	0.8	0.7	3.8	3.2	23.6	20.3	19.5	17.4	3.8	3.3	51.5	44.9

TABLE 6.—Number of Maple and Elm in 1922, 1935, and 1940.

Year	Number of trees per acre				Source
	SM	AE	SE	Total elm	
1922......	33	35	....	35	McDougall (1922)
1935......	36.5	15.7	11.9	27.6	Marberry (1936)
1940......	39.2	16.0	8.8	24.8	Vestal and Heermans (1945)

1922 and 1940 as shown in Table 6. McDougall (1922) did not mention the occurrence of slippery elm in the woodland. There is a possibility that it was included with American elm. The average diameter of 15.8 inches for slippery elm, calculated from the data of Vestal and Heermans (1945), lends some support to this idea. The figures given in Table 6 should be used with caution for reasons given in the review of past work. However, the proportion of maple to elm is probably a fairly true representation of stand composition. Differences in the 1935 and 1940 data are probably due to sample size and sampling techniques rather than any perceptible change during this relatively short period.

Some idea of composition changes between 1940 and the present can be gained by comparing the data of Vestal and Heermans (1945) with those of the current survey (Table 7).

The most obvious changes are the decrease in American elm, an increase in the number of slippery elm with a decided shift from large to small trees, and a substantial in-

TABLE 7.—Number of Trees and Basal Area Per Acre in 1940 and 1963.

Species	1940		1963	
	Number trees	Basal area	Number trees	Basal area
SM..........	39.2	34.6	37.81	27.49
AE..........	16.0	21.9	4.16	0.76
SE..........	8.6	11.4	17.96	3.04
L..........	10.4	11.6	11.99	6.01
WA..........	9.4	8.5	10.38	12.01
B..........	7.1	7.5	7.86	4.60
RO..........	2.8	8.5	2.81	11.23
BA..........	4.8	3.0	2.86	2.56
H..........	4.1	3.1	20.90	8.47
BW..........	3.0	5.5	3.96	4.93
BO..........	1.5	3.5	1.61	5.01
CO..........	1.2	2.2	0.40	1.38

crease in the number of hackberry. These increases are undoubtedly related to canopy openings created by elm mortality.

The number of sugar maple has not changed significantly. However, the decrease in basal area for this species between 1940 and 1963 is not realistic. Mortality of sugar maple, determined in the 1963 inventory, was only 1.4 square feet per acre. This is not a very large figure, particularly when spread over a period of 10 to 15 years. Thus, the apparent decline is unlikely and is probably related to the sampling bias that was weighted toward the south half of the woodland, where the concentration of maple was heaviest. Such bias would be more apparent in basal area than in tree numbers, since the former is a function of the square of the diameter. It is perhaps justifiable to assume that both the estimates of maple numbers and basal area in 1940 were too high. Certainly there is no other reason to believe that maple has decreased in the stand.

The proportion of maple in the north half of the woodland has changed from about one-fourth of the total in 1922 to 36.9 percent in 1963. However, areas shown on McDougall's map (1922) as having little or no maple are still in the same condition. These are the low, poorly drained sites where the concentration of elm was greatest.

Future Composition

Based on the amount of reproduction, the number of saplings, and the diameter distribution of the larger stems, sugar maple should continue, or perhaps increase, its dominance in the stand. The number of sugar maple seedlings (2,450 per acre) is almost as great for all other species combined. Thus, the future population of this very tolerant species is already established and can take advantage of canopy openings that occur with the death of older trees. This gap phase replacement has been shown to be important in the maintenance of sugar maple as a major dominant in a maple-basswood forest in southeastern Minnesota (Bray, 1956). Maple may also become more important on the dead elm areas, particularly where the soils are not too poorly drained.

Red oak will continue to be an important stand component for a number of years. However, there are very few red oak trees under 13 inches in diameter, which means that replacement will be limited as mortality occurs in the larger diameter classes. While there were about 220 red oak "seedlings" per acre, these apparently rarely develop into saplings. Bray (1956) pointed out that red oak seedlings in a maple-basswood stand did not respond to canopy openings because of the rapid growth of sugar maple seedlings which quickly overtopped the slower growing oaks. The above comments also hold true for bur oak and chinquapin oak.

Hackberry, now second in over-all importance, may well maintain this position, since it is well represented in the smaller diameter classes, and large trees are scattered throughout the woodland. Hackberry reproduction is second to that of maple but tends to be clumped as indicated by its low (16 percent) frequency of occurrence. The same conditions hold for the 1- and 2-inch diameter classes.

The proportions of basswood, buckeye, white ash, black walnut, etc., appear to be relatively stable and are not likely to change barring some event that would seriously affect the maple population. All of these species are present in the smaller diameter classes. While there are few basswood seedlings, the capacity of this species to sprout following the death of parent trees is well known, and in this way it will remain an important stand component.

The future of the sites formerly occupied by pure stands of elm is uncertain at present. They are now dominated by spice-bush and pawpaw, of which there are 375 and 250 per acre in the 1- and 2-inch diameter classes. In contrast there are very few spice-bush on the mixed hardwood and maple sites, but the number of pawpaw is from two to three times greater on these than on the dead elm areas. Reproduction of overstory species is largely composed of sugar maple, hackberry, and white ash with some black walnut, buckeye, and slippery elm. However, there are more sugar maple saplings than of all these other species combined. The number of maple seedlings on the dead elm sites is almost equal to that on the mixed hardwood and about half that on the maple sites. More intensive studies of succession on the dead elm sites are now in progress.

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Manuscript received May 12, 1964.