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Sixty Years of  
Natural Change  
in Unmanaged Mixed  
Hardwood Forests

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## SUMMARY

Natural changes during 60 years on a 10-acre sample in four unmanaged mixed hardwood tracts in south central Connecticut were recorded. Sample transects were established in 1926-27 and re inventoried each decade except during the 1940's. About a third of one tract burned in 1932. Canopy defoliation occurred one or more years in each decade during 1957-87. During 1957-67, drought accompanied defoliation. In 1927 there were 29 Major and seven Minor species present on the tracts. Stand density of Major species decreased gradually during the first four decades and increased during the last two decades. Minor species stand density decreased almost continuously during 60 years. During 1927-87 four intolerant Major and two Minor species disappeared from the sample. Over the same period, a numerical measure of diversity decreased 18%. During 60 years, diameter distribution shifted from 90% sapling and less than 1% sawtimber to 77% sapling, 15% pole and 8% sawtimber. Basal area of Major species increased from 63 ft<sup>2</sup>/A in 1927 to 108 ft<sup>2</sup>/A in 1987. Basal area was greatest on the Moist sites. Basal area of Minor species declined steadily during 60 years. Mortality of Major species was 362 stems/A during 1927-37, dropped to 152 stems/A during 1957-67, and decreased to 107 stems/A in 1977-87. Mortality of Minor species (stems/A) was greatest in 1927-37, decreased until 1957-67 and the rose again by 1977-87. Basal area mortality of Major species was greatest during 1957-67 (22 ft<sup>2</sup>/A) but decreased to 8 ft<sup>2</sup>/A by 1977-87. Ingrowth of Major species rose from 53 stems/A during 1927-37 to 231 stems/A during 1967-77 and then declined. Minor species ingrowth followed a similar pattern. Persistence of Major species decreased from 707 stems/A in 1927-37 to 355 stems/A in 1957-67, but then increased to 468 stems/A by 1977-87. Persistence of Minor species decreased steadily throughout the 60 years. The number of Major species stems in the upper canopy decreased steadily from 230/A in 1927 to 72/A in 1987. No Minor species were in the upper canopy after 1957. Upper canopy trees comprised 67% of Major species basal area in 1927, 79% in 1967 and 70% in 1987. Canopy mortality of Major species stems decreased steadily during 1927-87; basal area mortality increased during 1957-67. There was little ingrowth into the canopy.

Fire in 1932 reduced stand density about 80%, but by 1957 stand density was double the 1926 value. In 1987 stand density on the burned area was slightly less than on unburned sites. Fire removed about a third of basal area, more on the Dry site. Fire retarded stand development about 30 years.

Transition probabilities were used to summarize change over time and to attempt to predict the composition of the future forest. Transition probabilities based on stocking level of species groups predicted change for 10-30 years, but not 60. The transition probabilities did not meet the essential tests for stationary Markov chains. Lack of stationarity caused different estimates of the proportion in each species group over time. Nevertheless, estimates of the time to attain steady state appeared biologically reasonable, generally 200-400 years.

# Sixty Years of Natural Change in Unmanaged Mixed Hardwood Forests

BY GEORGE R. STEPHENS AND JEFFREY S. WARD

Connecticut is presently 59% forest or about 1.826 million acres (Dickson and McAfee 1988). This is a marked increase from the estimated 25% forest remaining in 1820 at the height of land clearing for crops and pasture (Harper 1918). More than half of Connecticut's forest has arisen during the past 170 years. The remaining original forest, as well as some of the new forest, has been repeatedly cut for fuelwood, charcoal or timber. Our knowledge of how a forest changes over time has been inferred from fragments in different successional stages. No single person lives long enough to record the changes that occur during the development of a high forest, perhaps two or three centuries. Our knowledge of how a forest changes over time is further complicated by repeated disturbance from fire and cutting. Ideally, opportunity to study forest change would be enhanced by long term observations on tracts protected from non-natural disturbance. This report presents observations during 60 years of change from a relatively young forest to one approaching maturity.

In 1926-27 Henry W. Hicock and others from The Connecticut Agricultural Experiment Station selected four tracts in south central Connecticut to study the association between soil type and forest composition (Hicock et al. 1931). Unfortunately for them, the eye of the soil surveyor was more discerning than that of the trees which grew upon the land; they were unable to show an association. However, their efforts established the basis of one of the oldest and largest sets of permanent plots in the eastern hardwood forest. These tracts, Turkey Hill, Cabin, Cox, and Reeves were first inventoried in 1926-27 and every decade thereafter except during the 1940's. Although observations on the Davis-Purdue Research Forest in Indiana also began in 1926 and contain a larger sample, the frequency of observations is less and only trees larger than 4 in. diameter breast height (dbh) were measured (Ward and Parker 1987).

The inventories were reported: the 1926-27 inventory by Hicock et al. (1931), the 1937 and 1957 inventories by Collins (1962) and Olson (1965), and the 1967 and 1977 inventories by Stephens and Waggoner (1970, 1980). For the convenience of the reader we repeat some of the data from earlier inventories and add the 1987 data. Totals may differ slightly from earlier reports because non-natural

disturbance has diminished the sample slightly and some earlier errors have been detected and corrected. The data are generally reported as number of stems or square feet of basal area per acre. This will allow interested readers to make direct comparisons with other data. We leave conversion to percentages or other measures to the reader.

## DESCRIPTION OF THE TRACTS

The Turkey Hill tract is in the Cockaponset State Forest in Haddam. The Cabin, Cox and Reeves tracts are located within the Meshomasic State Forest in the town of Portland. All are near the western end of the Eastern Highlands of Connecticut, a region of metamorphic rocks and glaciated soils. The topography is gently rolling to rugged with considerable rock outcrop. Elevation ranges from 400 to 800 feet. Turkey Hill is more exposed to strong easterly storm winds, whereas Cabin, Cox and Reeves are sheltered to the east by Meshomasic Mountain.

At the time of establishment, 1926 for Turkey Hill and 1927 for the remainder, the forest was estimated to be 20 to 40 years old (Hicock et al. 1931). A portion of all tracts had been cleared for grazing or mowing. Remnants of stone walls, barbed wire and the presence of pioneers such as gray birch and redcedar in 1927 indicated old field reverting to forest. Rugged terrain, rock outcrops, abundance of boulders, and presence of chestnut sprouts suggested that the tracts were never completely cleared, but portions were likely repeatedly cut for timber, fuel and charcoal. These tracts are typical of much of woodlands, not only in central Connecticut, but all of southern New England.

## WEATHER

During 1927-86 the average annual precipitation was 43.95 inches as measured until 1954 at Hartford, about 10 miles north of three of the tracts, and thereafter at Bradley International Airport, about 23 miles north of the tracts. The six decades, beginning with 1927-36, can be characterized as dry, moist, moist, very dry, very moist, and normal (Fig. 1). During 1927-36 precipitation

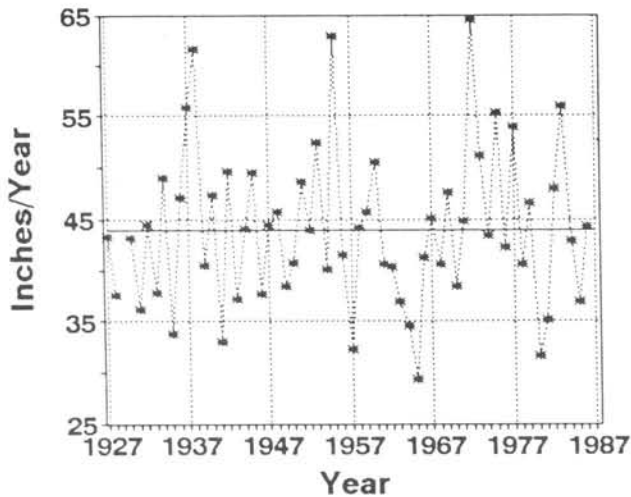


Figure 1. Annual precipitation (inches) during 1927-86 at Hartford, CT. Average annual precipitation is 43.95 inches.

alternated between average and below average. Although each of the next two decades was classified as moist, it was the abundant rain in 1938 and 1955 that made them moist, otherwise they were near average. The dry decade, 1957-66, had only three years with average or above average precipitation. The very moist decade, 1967-76, had only three years with precipitation below average. The final decade, 1977-86, alternated between periods of above average and below average precipitation.

## DEFOLIATION

The tracts have been subjected to three episodes of defoliation during the last three decades, 1957-87 (Table 1). During 1957-67 gypsy moth (*Lymantria dispar* L.) and canker worm (*Paleacrita vernata* Peck.) and other defoliators attacked the canopies of all four tracts. Aerial surveys indicated partial defoliation on Cox, Cabin and Reeves during 1961-63 and on Turkey Hill in 1964. During 1967-77 gypsy moth and elm spanworm (*Ennomos subsignarius* Hbn.) defoliated the tracts. Cox was defoliated most and Turkey Hill least. During 1977-87 gypsy moth defoliated the tracts heavily in 1981. Only Cabin was lightly defoliated again in 1982. The duration of each defoliation episode decreased over time, but defoliation intensity was greatest in 1981.

## DISEASE

Asiatic chestnut blight (*Cryphonectria parasitica* (Murr.) Barr) and Dutch elm disease (*Ceratocystis ulmi* (Buison.) C. Mor.) have been the principal diseases in the

tracts. By 1927, blight had killed all of the large chestnuts and has continued to kill chestnut sprouts. Dutch elm disease reached the tracts between 1937-1957. Although it devastated elms on town greens, it had less effect on the forest. As we shall see later, elm was never abundant in the forest. During 1977-87 many flowering dogwoods died. Although the cause of mortality was not determined, it is likely that the same combination of factors that devastated ornamental dogwoods during 1982-85 was responsible for dogwood mortality in the forest.

## METHODS

All four tracts were laid out as rectangles with the long axis east-west. The dimensions varied: Turkey Hill, 20 x 40 chains (1 chain = 66 ft); Cox, 14 x 36 chains; Reeves, 10 x 40 chains; and Cabin, 20 x 20 chains. North-south transects were 5 chains apart on Turkey Hill and 4 chains apart on all other tracts. Site characteristics such as soil type, soil depth, soil drainage or moisture, stoniness, humus type, slope, and aspect were determined and mapped along transects. Along a strip 0.25 chain wide and centered on the transect line, each stem equal to or greater than the minimum stem diameter at breast height (dbh), 4.5 ft above ground, was plotted on a map, identified, and described.

In 1926-27 description included dbh, crown class (on all tracts except Turkey Hill), and whether or not the stem was a member of a sprout clump. Minimum diameter was 0.6 in. and stems were recorded in the nearest 1-in. diameter class.

In 1937 the same information was recorded for stems tallied in 1926-27. Mortality of previously recorded stems and ingrowth 0.6 in. dbh or larger were included. Crown class of all stems on Turkey Hill was recorded.

In 1957 the same information was again recorded, but minimum dbh was decreased to 0.5 in. Members of a sprout clump were ranked in order of decreasing diameter. On a transect 0.125 chains wide on either side of

Table 1. Estimated canopy defoliation (percent) during 1961-82.

Year	Tract			
	Cabin	Cox	Reeves	Turkey Hill
	Percent Defoliation			
1961	26-50	26-50	26-50	0-10
1962	51-75	51-75	51-75	0-10
1963	26-50	26-50	51-75	0-10
1964	0-10	0-10	0-10	25-75
1971	26-50	76-100	26-50	10-25
1972	51-75	51-75	51-75	51-75
1981	76-100	76-100	76-100	76-100
1982	10-25			

Table 2. Distribution of soil moisture classes (acres) in undisturbed sample in 1987.

Tract	Wet	Moist	Med. Moist	Dry	All Sites
Turkey Hill	0.237	0.467	1.565	0.095	2.364
Cox	-	0.513	2.002	0.597	3.112
Reeves	-	0.316	1.365	0.687	2.369
Cabin	-	0.335	1.820	-	2.155
All Tracts	0.237	1.631	6.753	1.380	10.001

the original transect all stems at least 10.0 in. dbh were recorded. The total height of all dominant trees and every tenth other tree was measured with an Abney level. Trees measured for height and any companion sprouts were also examined for stem and crown defects. The defects were of form and symmetry and external injury to crown and stem. Internal defects such as heartrot were not included.

In 1967, 1977 and 1987 all stems at least 0.5 in. dbh were located and described as above. New sprout ranks were assigned where mortality removed or ingrowth added stems. In 1987 the perpendicular distance of each stem from the centerline of the transect was measured and recorded.

In 1932 a fire burned approximately 40% of Turkey Hill. In 1934 the burned area was reinventoried as in 1926. Mortality, ingrowth, and crown class were recorded along with the intersection of the fire boundary with the transect. Trees alive in 1926 but dead in 1934 were arbitrarily assigned the lowest crown class.

Beginning in 1957, human disturbance on the tracts from road construction and cutting was recorded. About 73% of the original 13.75 acres in the transects remained undisturbed through 1987. Areas disturbed at any time during the 60 years were omitted from the analysis.

#### SITE CHARACTERISTICS

The four tracts are representative of forests of the region and comprise a mosaic of previous land use. Some land was cleared of the original forest but later allowed to revert to forest; some has always been forested but repeatedly cut. Remnants of fence wire suggest pasture or grazed woodland. Stonewalls suggest clearing. The presence of pioneer species such as redcedar, gray birch and blue-beech suggest land abandoned from agriculture and allowed to revert to forest. In 1927 the presence of these pioneers on Cox indicated that much of the forest there was the youngest. Remnants of fences, stonewalls and pioneer species on Reeves and Turkey Hill indicated that portions of these tracts had recently reverted to forest. On Cabin the absence of pioneers, fences and stonewalls, and the abundance of rocks suggested that this tract was never completely cleared but remained in forest.

Although soil type, depth of soil, internal soil drainage, stoniness, humus type, and aspect were determined along each transect (Hicoek et al. 1931), only internal soil drainage has been found useful for relating vegetation to site characteristics. Soil drainage classes were classified according to the Soil Survey Manual (USDA 1951). In addition to the seven classes described in the manual, an eighth class, muck, was added to describe the swamp on Turkey Hill. Because the area sampled in some moisture classes was small, the eight classes were condensed to four: Wet, swamp or muck; Moist, which included very poorly drained and poorly drained; Medium Moist, which included imperfectly or somewhat poorly drained, moderately well drained, and well drained; and Dry, which included somewhat excessively drained and excessively drained soils. The area of the combined moisture classes is shown in Table 2.

#### STAND DENSITY

Major species comprise those species that are normally long lived and form the main canopy of a stand. Minor species are those which do not grow large at maturity and generally do not appear in the canopy except in very young stands. Chestnut blight has forced American chestnut into this category. Intolerant pioneer species such as redcedar and gray birch, which may be abundant for a time and then disappear, are included also as Minor. During 1927-67, over all tracts and moisture classes, the number of stems declined steadily (Fig. 2). However, during 1967-87 the number of Major species stems

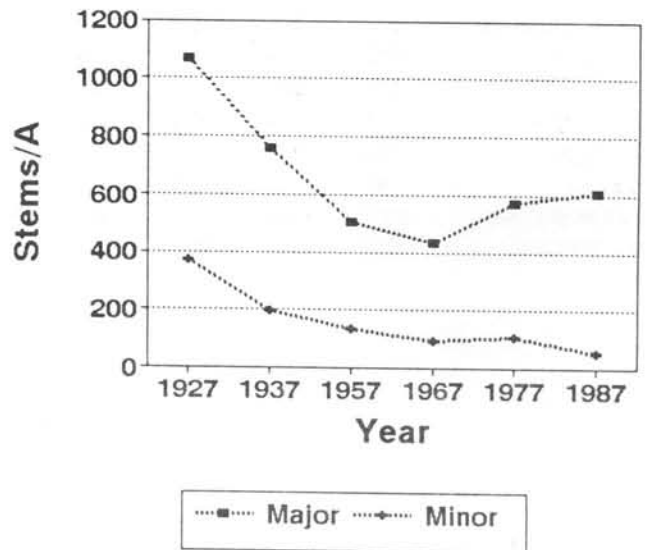


Figure 2. Average stand density (stems/A) of Major and Minor species over all tracts and sites during 1927-87.



Table 3a. Stand density (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

SPECIES	All Sites						Moist					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	37.6	34.4	34.6	32.4	33.8	34.9	78.5	76.6	74.8	68.7	64.4	64.4
Red maple	271.2	196.4	142.5	140.5	182.7	171.2	283.3	205.4	133.7	108.5	106.1	100.6
Bitternut hickory	2.3	1.1	.2	.1	.3	.3	2.5	1.2	N	N	1.2	1.2
Mockernut hickory	13.5	9.7	5.6	2.4	.8	.9	4.3	1.8	.6	.6	.6	.6
Pignut hickory	47.1	26.4	10.6	5.4	3.1	4.1	11.0	8.0	3.7	1.2	4.9	8.0
Shagbark hickory	10.0	7.2	4.9	3.0	1.4	1.4	8.6	6.7	5.5	3.7	3.7	3.7
Northern red oak	99.8	71.3	43.1	25.1	19.9	20.6	73.6	60.1	40.5	20.2	14.1	14.7
Black oak	36.3	27.8	16.1	8.9	8.9	10.5	10.4	6.7	3.1	1.2	1.2	1.2
Scarlet oak	22.4	17.2	12.6	7.9	6.6	5.9	9.8	9.2	4.9	2.5	2.5	2.5
White oak	130.6	80.9	26.4	8.2	6.8	8.0	41.7	20.2	11.0	2.5	2.5	3.1
Chestnut oak	31.2	24.8	18.9	6.9	8.4	9.4	17.2	19.6	8.0	2.5	3.1	.6
Yellow birch	88.4	70.4	60.9	56.1	98.4	119.3	165.5	142.9	114.7	103.0	170.4	206.0
Black birch	123.2	96.7	73.3	80.0	114.1	126.7	45.4	36.2	32.5	36.2	64.4	71.7
Paper birch	.7	.6	.7	.5	.2	.1	N	N	N	N	N	N
Beech	14.1	13.2	16.8	22.6	39.8	50.9	1.8	1.8	16.6	20.2	31.3	45.4
White ash	66.7	42.3	19.4	11.7	7.4	5.6	66.8	45.4	28.8	19.0	14.7	10.4
Black ash	.9	.5	.3	.6	.7	1.0	2.5	1.8	1.2	1.2	2.5	4.3
Basswood	3.2	2.0	.7	.2	.1	.1	3.7	3.7	1.2	N	N	N
Tulip	11.8	9.2	5.5	5.1	10.2	14.3	11.0	10.4	5.5	4.9	22.7	31.3
American elm	5.8	3.8	2.3	1.3	.3	.3	23.9	16.6	9.2	3.7	.6	.6
Bigtooth aspen	14.0	8.5	.4	.1	N	N	34.9	22.1	N	N	N	N
Quaking aspen	.1	.1	N	N	N	N	.6	.6	N	N	N	N
Tupelo	8.0	5.7	4.1	4.4	8.2	8.7	19.6	14.7	11.6	12.9	30.7	30.7
Black locust	.3	.1	.1	.1	.1	.1	N	N	N	N	N	N
Butternut	4.3	1.0	.1	N	.1	N	3.7	.6	N	N	N	N
Black cherry	11.0	1.7	.1	N	.1	.6	33.1	5.5	.6	N	N	N
Sassafras	13.7	6.6	6.3	10.4	21.7	15.1	11.6	4.9	9.2	8.6	11.6	6.7
White pine	.1	.2	.7	.1	.3	.3	N	.6	N	N	N	N
Hemlock	.3	.3	.3	.3	.4	.3	.6	.6	.6	.6	.6	.6
MAJOR SPECIES	1068.5	760.0	507.3	434.2	574.7	610.4	965.7	724.1	517.5	421.8	553.6	608.2
Chestnut	11.8	1.6	36.3	39.5	48.3	14.5	3.1	.6	12.3	9.2	15.3	4.3
Flowering dogwood	39.7	33.8	28.3	30.6	41.6	6.8	16.6	11.0	15.3	21.5	27.0	5.5
Blue-beech	192.0	102.1	52.5	18.1	11.2	18.0	287.6	164.3	96.9	39.9	23.9	32.5
Shadbush	17.9	13.5	2.5	1.3	1.2	.7	27.0	21.5	3.7	1.2	3.1	.6
Hophornbeam	35.6	19.9	15.2	2.0	2.8	13.4	32.5	20.8	29.4	2.5	2.5	6.7
Gray birch	71.3	28.0	.8	.1	.1	N	94.4	35.6	1.2	N	N	N
Redcedar	3.4	.2	.1	N	N	N	N	N	N	N	N	N
MINOR SPECIES	371.7	199.1	135.7	91.6	105.2	53.4	461.1	253.8	158.8	74.2	71.7	49.7
ALL SPECIES	1440.2	959.1	643.0	525.7	679.9	663.8	1426.7	977.9	676.3	496.0	625.4	657.9

Table 3b. Stand density (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

SPECIES	Medium Moist						Dry					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	34.4	30.5	30.9	29.5	31.8	33.6	11.6	9.4	10.9	8.7	13.0	12.3
Red maple	267.9	194.9	139.5	139.8	189.7	176.2	294.2	201.4	159.4	174.6	242.8	235.5
Bitternut hickory	2.8	1.3	.3	.1	.1	.1	N	N	N	N	N	N
Mockernut hickory	14.4	10.2	6.4	2.5	.9	.9	22.5	18.1	8.7	4.3	.7	1.4
Pignut hickory	46.3	23.2	10.7	5.8	3.1	3.3	101.4	68.1	20.3	9.4	1.4	4.3
Shagbark hickory	11.3	7.8	5.5	3.6	1.2	1.2	7.2	5.8	2.2	N	N	N
Northern red oak	110.5	76.6	45.0	26.1	20.1	20.4	95.7	71.0	43.5	29.7	28.3	31.9
Black oak	31.7	23.8	15.0	8.1	8.7	9.5	95.7	76.8	39.9	23.2	20.3	28.3
Scarlet oak	21.9	15.7	12.4	7.8	6.1	5.0	43.5	37.0	24.6	15.9	15.2	15.2
White oak	143.8	84.7	26.5	8.6	6.8	7.4	193.5	147.8	48.6	14.5	13.0	18.1
Chestnut oak	37.3	28.4	23.5	7.4	9.0	10.2	23.2	17.4	12.3	10.9	13.0	17.4
Yellow birch	89.0	68.3	60.7	56.1	101.0	123.1	8.7	6.5	5.8	8.0	15.2	16.7
Black birch	137.9	107.1	77.9	83.8	114.6	126.3	164.5	134.1	110.9	125.4	189.1	214.5
Paper birch	1.0	.9	1.0	.7	.3	N	N	N	N	N	N	N
Beech	15.3	13.6	15.5	22.5	40.6	50.5	25.4	26.8	26.1	29.7	52.9	68.1
White ash	76.9	46.3	19.0	11.0	6.5	5.0	24.6	21.7	5.1	.7	N	N
Black ash	.6	.1	N	N	.1	.1	N	N	N	.7	N	N
Basswood	3.9	2.1	.7	.3	.1	.1	N	N	N	N	N	N
Tulip	14.5	11.0	6.7	6.2	9.3	13.2	1.4	.7	.7	.7	1.4	2.2
American elm	1.8	1.2	.4	.3	.1	.1	.7	N	N	N	N	N
Bigtooth aspen	8.1	5.8	.6	.1	N	N	20.3	7.2	N	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N	N	N
Tupelo	6.1	4.6	3.0	3.3	4.6	5.3	3.6	1.4	1.4	.7	.7	.7
Black locust	N	N	N	N	N	N	2.2	.7	.7	.7	.7	.7
Butternut	4.0	.9	N	N	.1	N	7.2	2.2	N	N	N	N
Black cherry	6.1	.9	N	N	.1	.9	10.9	1.4	N	N	N	N
Sassafras	13.6	7.3	5.9	10.2	24.0	17.2	18.8	6.5	5.8	15.2	26.1	17.4
White pine	.1	.1	1.0	N	.4	.3	N	N	N	N	N	.7
Hemlock	.3	.3	.3	.3	.4	.3	N	N	N	N	N	N
MAJOR SPECIES	1101.3	767.7	508.6	434.2	580.2	610.4	1176.8	862.3	526.8	473.2	634.1	685.5
Chestnut	11.6	1.5	41.8	46.2	49.8	16.3	25.4	3.6	44.2	49.3	88.4	20.3
Flowering dogwood	50.2	44.1	36.4	38.4	53.2	8.6	22.5	15.9	8.7	8.7	9.4	.7
Blue-beech	204.2	105.1	50.6	16.4	10.2	17.6	50.0	29.7	14.5	1.4	2.2	5.1
Shadbush	15.0	11.8	2.1	.9	.7	.9	23.9	13.8	2.9	2.9	1.4	N
Hophornbeam	41.6	21.5	12.7	2.2	3.1	17.8	15.9	14.5	13.0	.7	2.2	2.2
Gray birch	69.0	27.0	.9	.1	N	N	67.4	29.0	N	N	.7	N
Redcedar	4.4	.3	.1	N	N	N	2.9	N	N	N	N	N
MINOR SPECIES	395.9	211.3	144.6	104.2	117.0	61.2	208.0	106.5	83.3	63.0	104.3	28.3
ALL SPECIES	1497.3	979.0	653.2	538.4	697.2	671.6	1384.8	968.8	610.1	536.2	738.4	713.8

increased. Minor species density increased slightly in 1967-77. During 1977-87 the high mortality of chestnut and flowering dogwood reduced density of Minor in 1987 below the level of 1967. The pattern of decreasing and then increasing numbers of stems occurred on all moisture classes except the Wet site.

For convenience, Major species were subdivided into species groups: Birch, black and yellow birch; Maple, red and sugar maple; Oak, red, black, scarlet, white, and chestnut oak; and Other, all 20 remaining Major species. In 1927, over all tracts and sites, three Major species groups dominated stand composition (Fig. 3). Maple comprised 28%; Birch, nearly 20%; and Oak, 30% of Major species stems. By 1987 Maple increased to 34%, Birch to 40, but Oak dwindled to only 9% of Major species stems. Stand density of American beech and tulip increased steadily during 60 years (Table 3). Among Minor species, stand density of blue-beech and hophornbeam increased during 1977-87. During 1977-87 American chestnut declined from 45 to 27% of Minor species stems, while flowering dogwood declined from 40 to 12%. The increase in blue-beech and hophornbeam was insufficient to offset the losses of chestnut and dogwood. Among tracts, Major species declined through 1967 and then increased on Cabin and Reeves. On Cox they increased in 1977, but not in 1987. On Turkey Hill, Major species continued to decline through 1977 and remained unchanged in 1987. On Cabin and Turkey Hill, Minor species continued to decline during 1927-87.

#### DIVERSITY

In 1927 there were 29 Major tree and seven Minor tree species present (Table 3). During the next 60 years, four Major and two Minor species disappeared from the sample. During 1937-57 quaking aspen disappeared. Redcedar disappeared during 1957-67. Bigtooth aspen was lost in 1967-77. During 1977-87 butternut, and paper and gray birches disappeared. Although never abundant, bitternut hickory, black cherry, basswood, and American elm have become rare. Black locust, white pine and hemlock have always been rare on these tracts.

Pielou (1966) devised a mathematical measure of diversity:

$$\frac{1}{N} \log_2 \frac{N!}{N_1! N_2! \dots N_s!} \text{ bits/individual}$$

where N is the total number of individuals on the tract and  $N_1, N_2, \dots, N_s$  are the number of stems in the first, second, ..., and last of s species. Diversity decreases as number of species decreases, as number of individuals decreases, or as individuals are concentrated in fewer species.

The diversity for each moisture class and decade appears in Table 4. Over all sites, diversity decreased with

Table 4. Diversity (bits/individual) during 1927-87.

Site	1927	1937	1957	1967	1977	1987
Wet	1.57	1.29	1.74	1.85	1.33	1.28
Moist	3.74	3.69	3.58	3.36	3.38	3.21
Medium	3.99	3.92	3.85	3.54	3.34	3.29
Dry	3.80	3.64	3.44	3.04	2.86	2.79
All Sites	4.03	3.96	3.87	3.57	3.39	3.33

time, something we have already seen with the loss of six species and about 800 stems/acre. Because each site did not contain all species, diversity on individual moisture classes was lower than over all sites. Despite the increased stand density in 1977 and 1987 on all moisture classes, diversity did not increase. The trend of decreasing diversity was halted only on the Moist site in 1977. Apparently, the loss of species far outweighed increased stand density in the calculation of the diversity index. On the Wet site, with only 13 species and a fraction of stand density of other sites, diversity was clearly lower and more variable over time than on the other sites.

#### DISTRIBUTION OF DIAMETER

In a young even-aged forest the stem diameters are, of necessity, small. However, some trees grow faster than others and over time a range of diameters develops. In 1927, over all tracts and moisture classes, nearly 90% of Major and Minor species stems were saplings, 0.5-4.5 in. dbh (Table 5). Most of the remainder were poles, 4.6-10.5 in. dbh. Less than 1% were sawtimber; i.e., greater than 10.5 in. dbh. After 60 years there were 77% saplings, 15% poles, and 8% sawtimber. The large increase in sapling density during 1967-77 decreased the proportion of sawtimber and poles in 1977 and 1987. The number of sawtimber stems actually increased through 1987, while poles declined steadily until 1977.

Among soil moisture classes the proportion of saplings, poles and sawtimber differed little, except on the Wet site where there were proportionately fewer saplings and more poles.

In 1927 Cox had nearly twice as many saplings as Turkey Hill and Cabin, but almost no sawtimber. Among the tracts, only Turkey Hill failed to have a large increase in sapling density during 1967-77. On Turkey Hill, Cox and Reeves sawtimber density increased steadily during 1927-87. On Cabin the loss of sawtimber stems during 1957-67 was barely replaced by 1987.

#### BASAL AREA

The maturity of the stands is shown in the marked increase in basal area (cross sectional area of the stems at



Table 5a. Diameter distribution (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

Diameter Class (in)	All Sites						Moist					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
0.5 - 2.5	1025.4	529.1	336.5	293.5	449.7	426.6	936.8	503.4	347.0	248.9	401.0	413.2
2.6 - 4.5	265.0	220.4	110.6	78.5	84.1	84.0	293.7	221.9	117.1	72.3	69.9	77.9
4.6 - 6.5	90.9	108.4	73.9	48.3	43.3	45.7	115.3	134.9	77.3	48.4	38.6	44.8
6.6 - 8.5	34.3	51.6	44.8	34.8	32.3	31.4	45.4	58.9	51.5	42.3	33.1	31.3
8.6 - 10.5	14.6	27.9	31.8	23.1	20.7	21.2	20.2	27.6	34.3	28.2	27.0	26.4
10.6 - 12.5	5.0	11.9	21.7	18.2	16.1	17.0	6.1	18.4	21.5	23.3	20.8	22.1
12.6 - 14.5	2.8	5.7	12.2	13.1	13.2	11.8	4.9	8.6	11.6	12.3	15.3	15.9
14.6 - 16.5	1.5	2.1	6.7	8.6	9.4	10.6	3.7	1.2	10.4	10.4	8.6	10.4
16.6 - 18.5	.4	1.3	2.7	4.1	5.7	6.1	N	3.1	1.2	5.5	4.3	5.5
> 18.5	.3	.7	2.2	3.6	5.5	9.5	.6	N	4.3	4.3	6.7	10.4
Saplings	1290.4	749.5	447.1	372.0	533.7	510.5	1230.5	725.3	464.1	321.3	470.9	491.1
Poles	139.8	187.9	150.5	106.2	96.3	98.3	180.9	221.3	163.1	118.9	98.7	102.4
Sawtimber	10.0	21.7	45.5	47.6	49.9	55.0	15.3	31.3	49.0	55.8	55.8	64.4
All Classes	1440.2	959.1	643.0	525.7	679.9	663.8	1426.7	977.9	676.3	496.0	625.4	657.9

Table 5b. Diameter distribution (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

Diameter Class (in)	Medium Moist						Dry					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
0.5 - 2.5	1085.1	548.5	345.6	307.4	466.5	436.4	1002.2	550.7	315.9	313.8	497.1	465.2
2.6 - 4.5	263.3	222.6	113.9	82.9	87.1	84.9	275.4	234.1	88.4	62.3	91.3	96.4
4.6 - 6.5	88.3	104.5	71.4	46.3	44.4	46.8	80.4	103.6	85.5	52.9	39.1	42.0
6.6 - 8.5	35.1	50.3	41.5	30.8	30.1	30.1	18.1	53.6	55.8	42.8	39.1	31.2
8.6 - 10.5	14.7	30.4	33.3	23.0	18.2	19.3	7.2	18.8	26.1	21.0	26.1	23.9
10.6 - 12.5	5.8	11.8	22.1	17.3	15.4	15.4	.7	5.1	23.2	19.6	16.7	21.0
12.6 - 14.5	2.8	5.9	13.3	13.3	13.2	11.1	.7	2.2	9.4	14.5	12.3	10.9
14.6 - 16.5	1.3	2.7	6.4	9.2	9.8	10.8	N	.7	5.1	5.1	10.1	11.6
16.6 - 18.5	.6	1.2	3.7	4.1	6.5	6.1	N	N	N	2.9	4.3	8.0
> 18.5	.3	1.0	2.1	4.0	6.1	10.8	N	N	.7	1.4	2.2	3.6
Saplings	1348.4	771.1	459.5	390.3	553.5	521.2	1277.5	784.8	404.3	376.1	588.4	561.6
Poles	138.0	185.3	146.2	100.1	92.7	96.1	105.8	176.1	167.4	116.7	104.3	97.1
Sawtimber	10.8	22.7	47.5	48.0	50.9	54.2	1.4	8.0	38.4	43.5	45.7	55.1
All Classes	1497.3	979.0	653.2	538.4	697.2	671.6	1384.8	968.8	610.1	536.2	738.4	713.8

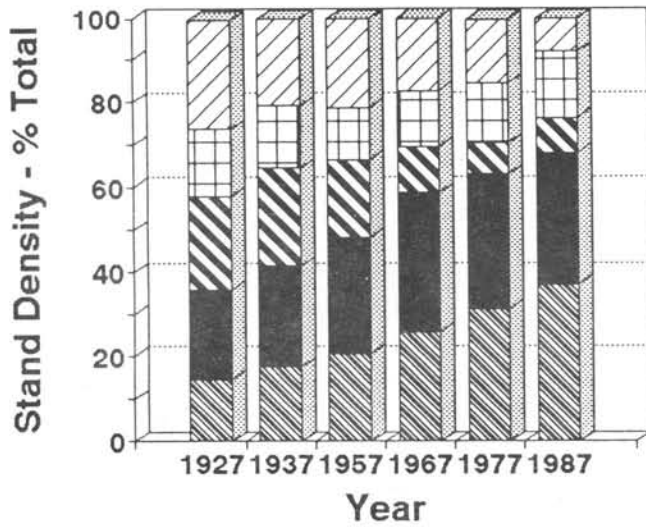
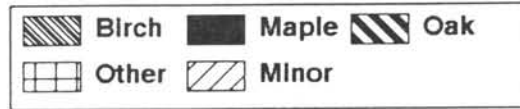


Figure 3. Percentage of stand density contributed by species groups during 1927-87. Average over all tracts and sites.

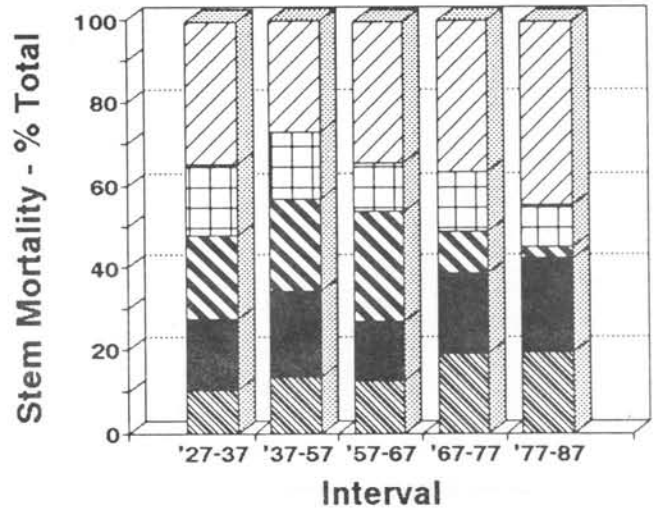


Figure 5. Percentage of periodic stem mortality contributed by species groups during 1927-87. Average over all tracts and sites.

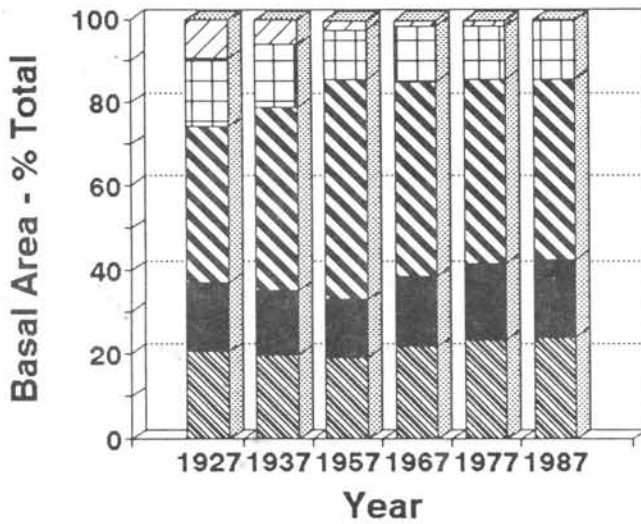


Figure 4. Percentage of stand basal area contributed by species groups during 1927-87. Average over all tracts and sites.

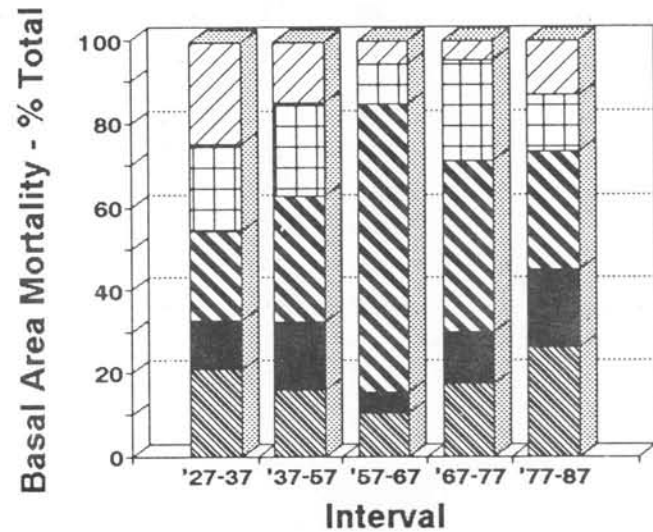


Figure 6. Percentage of periodic basal area mortality contributed by species groups during 1927-87. Average over all tracts and sites.

dbh) during 60 years (Table 6). Major tree species contributed the increase; basal area of Minor tree species decreased steadily since 1927 (Fig. 4).

Over all tracts and sites, red and black oak basal area continued to increase. White and chestnut oak basal area has decreased since 1957. Basal area of Maple increased steadily during 60 years. Similarly, basal area of Birch has increased steadily since 1927. However, basal area of each species, as a proportion of Major species basal area, scarcely changed except for Oak. In 1927 Oak comprised 37% of Major species basal area; by 1987, 43%. In 1927 Maple contributed about 16%; in 1987, about 18%. In 1927 Birch comprised nearly 21%; in 1987, 24%. Basal area of American beech and tulip increased steadily during 60 years. The proportion of total basal area contributed by these species increased from 3% in 1927 to nearly 10% in 1987.

Moist sites consistently supported more basal area of Major and Minor species than drier sites. However, during 60 years the increases were greater on the drier sites than on the Moist. Conversely, decrease in basal area of Minor species was greater on Moist than on drier sites.

Basal area of Major species has increased on all tracts since 1927. However, Cabin, Cox and Reeves tracts all lost basal area during 1957-67, a decade of repeated defoliation on those tracts. Decreases in basal area during 1957-67 were due almost entirely to mortality of white and chestnut oaks. On Turkey Hill, basal area of Major species decreased slightly only during 1967-77. On all tracts, basal area of Minor decreased steadily during 1927-87. During 1977-87 the decrease was due almost entirely to mortality of American chestnut and flowering dogwood.

## MORTALITY

In an even-aged forest with abundant stems, mortality is a natural event. As some individuals increase in size others are overtopped and crowded out of existence. Storms topple or break other stems. Insects and disease exact their toll. Periodic mortality (stems/A) from all natural causes is shown in Table 7. Over all tracts and sites, periodic mortality of Major species, as a percentage of stems present at the beginning of a period, decreased from 34% during 1927-37 to less than 19% during 1977-87. Pioneer species such as black cherry, sassafras, and aspen had very high mortality. Quaking aspen disappeared from the sample by 1957, and bigtooth aspen by 1977. Mortality of sugar maple was low in 1927-37, 18%, and further decreased to 11% during 1977-87. Percent mortality of red maple decreased through 1977 and then increased during 1977-87. Oak mortality during 1927-37 ranged 24 to 42% among the species. During 1957-67 mortality of all oaks increased, 37 to 70%. During 1977-87 mortality of red and black oak decreased to about 6%

whereas mortality of other oaks ranged 15 to 23%. Throughout the 60 years, mortality of white and chestnut oak was greater than for other oaks. During 1927-37 Birch mortality ranged from 27 to 29%. Mortality of yellow birch decreased steadily to 16% during 1977-87. Mortality of black birch remained nearly constant, 11 to 13%, during 1967-87. Paper birch mortality increased beginning in 1957-67, and it finally disappeared from the sample by 1987. Among Minor species, redcedar disappeared by 1967 and gray birch, by 1987.

Among species groups, Minor species contributed from a third to nearly half of periodic mortality (Fig. 5). The percentage of Oak mortality was greatest during 1957-67 and least in 1977-87. Birch and Maple mortality generally increased during 1927-87.

Among sites, Major species periodic mortality was greatest on the Medium Moist site, ranging from 35% in 1927-37 to 20% in 1977-87. Mortality on the Dry site, 32% in 1927-37 and 18% in 1977-87, was only slightly higher than on the Moist site, 31 and 16%. Mortality of sugar maple increased from Moist to Dry. Mortality of red maple was similar on all sites. Mortality of Oak was greatest on the Moist site, especially prior to 1967, and least on the Dry site.

Among the tracts, periodic mortality of Major species generally decreased during 1927-87. On Turkey Hill periodic mortality was always less than on the three other tracts. On Cabin mortality during 1977-87 was slightly greater than during 1967-77. During 1927-37 mortality was highest on Cox, 40%, and least on Turkey Hill, 11%. During 1977-87 mortality was again highest on Cox, 21%, and lowest on Turkey Hill, 6%.

Mortality, expressed as number of stems, does not tell whether the trees that died were large or small. Unless the number of trees dying is very large, basal area gives a better estimate of the size of trees dying and the impact of mortality on the forest. Over all tracts and sites, mortality of all species rose from 10.9 ft<sup>2</sup>/A during 1927-37 to 23.8 ft<sup>2</sup>/A during 1957-67 and declined to 9.5 ft<sup>2</sup>/A during 1977-87 (Table 8). Basal area mortality of red maple, as a percentage of basal area at the beginning of an interval, ranged from 11 to 13% each decade. During 1927-37 basal area mortality of sugar maple was about 10%; during 1977-87 it was less than 3%. Among Oak, basal area mortality ranged from 6 to 12% during 1927-37. During 1957-67, basal area mortality was 18 to 26% for the red oak group, but 54 to 66% for white and chestnut oak. During 1977-87, Oak basal area mortality ranged 3 to 16%. Scarlet and chestnut oak had the highest mortality. Periodic basal area mortality of Birch was variable. Yellow birch basal area mortality rose from 12% during 1927-37 to 19% in 1957-67 and decreased to 8% during 1977-87. On the other hand, basal area mortality of black birch decreased from 19% during 1927-37 to 10% in

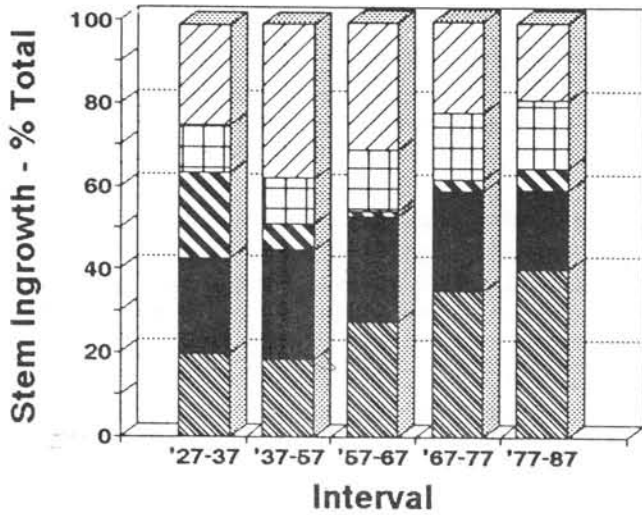
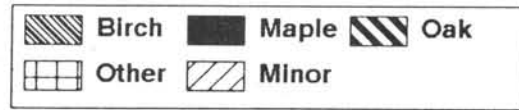


Figure 7. Percentage of periodic stem ingrowth contributed by species groups during 1927-87. Average over all tracts and sites.

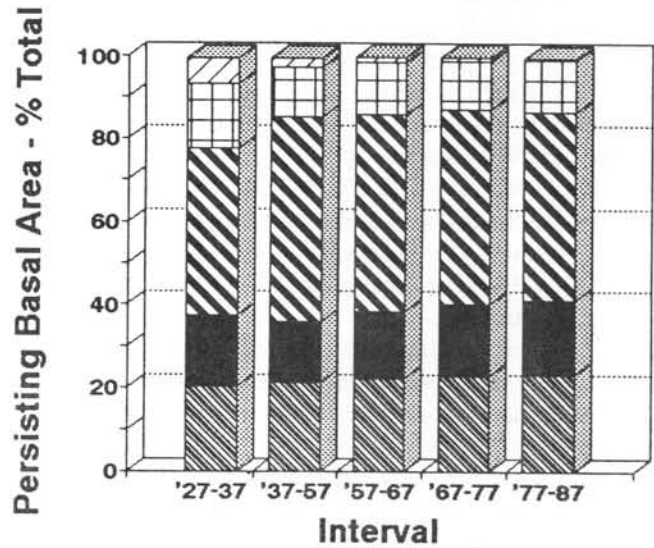


Figure 9. Percentage of basal area persisting throughout an interval by species groups during 1927-87. Average over all tracts and sites.

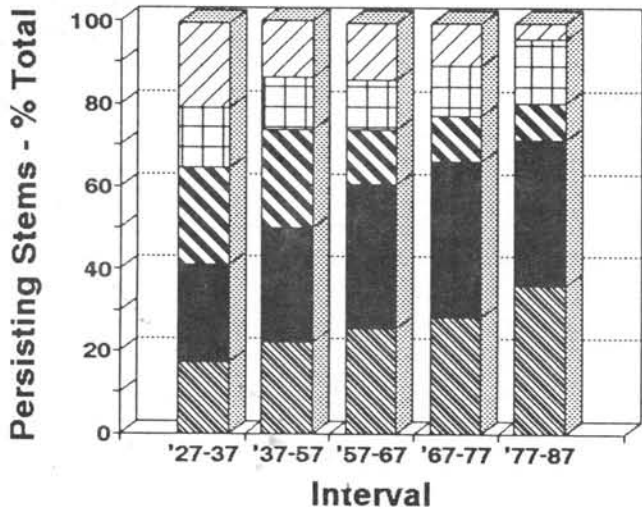


Figure 8. Percentage of stems persisting throughout an interval by species groups during 1927-87. Average over all tracts and sites.

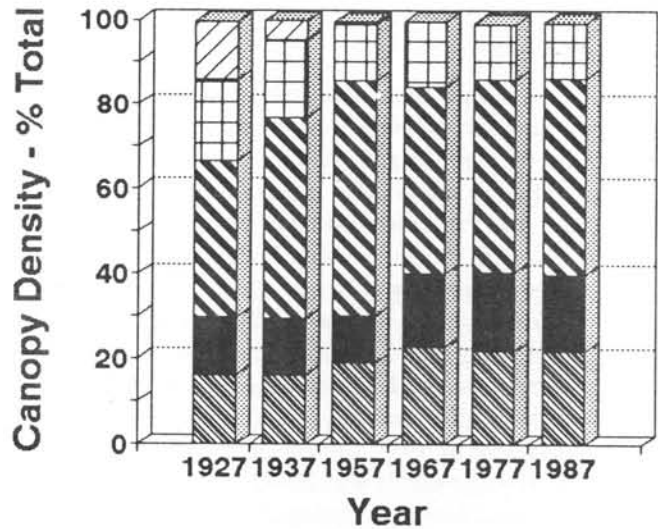


Figure 10. Percentage of canopy density contributed by species groups during 1927-87. Average over all tracts and sites.



1957-67 and rose again to 13% during 1977-87. Basal area mortality of Minor species remained above 40% during 1927-77 and rose to nearly 80% during 1977-87, mostly because of the large mortality of American chestnut and flowering dogwood.

Among species groups, Oak contributed the greatest mortality during 1927-87 (Fig. 6). It has decreased since 1967-77. The proportion of basal area mortality of Birch and Maple has increased since 1957.

## INGROWTH

Ingrowth is the number of new recruits that have grown to at least the minimum diameter. Because the stems are small, they contribute little basal area unless their number is great. We report periodic ingrowth (stems/A) in Table 9. Over all tracts and sites, ingrowth of Major species increased each decade except 1977-87. Expressed as a percent of Major species stems present at the end of a period, ingrowth of Major species was 7% during 1927-37, peaked at 40% in 1967-77, and decreased to 23% during 1977-87. Ingrowth of Minor species remained relatively constant except during 1967-77 when it doubled. However, expressed as a percent of Minor species stems present at the end of the period, Minor species ingrowth was 9% in 1927-87, peaked at 63% during 1967-77, and remained constant at 62% during 1977-87. Ingrowth, as stems/A, was greatest among red maple, yellow and black birch, and beech. Ingrowth of Oak, although only a few stems per acre, was greater during 1967-87 than at any other time since 1927-37. Among Minor species, ingrowth of chestnut sprouts and flowering dogwood decreased markedly during 1977-87, whereas ingrowth of blue-beech and hophornbeam increased.

As a percentage of total ingrowth, Birch has increased since 1957-67 (Fig. 7). The proportion of Maple ingrowth remained nearly steady during 1927-77. Oak ingrowth has gradually increased since 1957-67.

Total ingrowth of Major species differed little among sites (Table 9). During 1967-77 there were marked increases of Minor species ingrowth on Medium Moist and Dry sites. During 1927-87, ingrowth of sugar maple was greatest on the Moist site; red maple ingrowth was greatest on the Dry. Oak ingrowth was clearly greater on the Dry site, especially during 1977-87. Ingrowth of yellow birch was greatest on the Moist site and least on the Dry; the reverse was true for black birch. On the Medium Moist site, ingrowth was about equal for both species. On all sites, red maple and the birches comprised about half of Major species ingrowth since 1957.

Among tracts, ingrowth of Major species generally increased during 1927-87, except on Turkey Hill, where it remained nearly constant through 1977 and then declined.

Over all tracts, red maple, and yellow and black birch contributed most ingrowth. On Cox, Cabin and Reeves these three species contributed 38 to 68% of ingrowth. On Turkey Hill they contributed only 23 to 36%. On Turkey Hill, sugar maple comprised a much larger proportion of ingrowth, 8 to 12%, than on the other tracts. On Turkey Hill, Major species contributed 56 to 67% of total ingrowth during the six decades. On Cox, Major species contributed 67 to 82% of ingrowth; on Reeves, 52 to 85%; and on Cabin, 62 to 94%. On Cox, Reeves and Cabin, but not Turkey Hill, the percentage of Major species ingrowth increased over time.

## PERSISTENCE

In the section entitled, "STAND DENSITY", we saw the net change in number of stems from decade to decade (Table 3). Subsequently, we examined "MORTALITY" (Tables 7, 8) and "INGROWTH" (Table 9), two important factors affecting net change. However, in order to better understand the dynamics it is necessary to examine the remaining component of change, which is persistence. For example, stand density could remain relatively stable if persistence were high and ingrowth and mortality were both low. Over time there would be little net change. On the other hand, the same result could be achieved if persistence were low but ingrowth and mortality were both high. However, the population dynamics would be very different. The former would be a stable population, the latter, a population with great turnover. We show persistence in Table 10.

Over all tracts and sites, persistence of Major species, as a percent of stems present at the beginning of a period, increased from 66% during 1927-37 to 81% during 1977-87. These values for the entire stand closely approximate persistence of stems in the canopy; therefore, persistence is largely a function of large trees in the canopy. The increase in persistence over time indicates that position of the survivors is well established in the stand.

The proportion of persisting stems that was Birch or Maple increased over time (Fig. 8). The proportion of persisting Oak and Minor decreased. The proportion due to Other remained nearly constant during 1927-77, but increased slightly during 1977-87.

Persistence of tolerant sugar maple was high, 82% in 1927-37 and 89% in 1977-87. Persistence of red maple was more variable; it ranged from 68% in 1927-37 to 83% in 1967-77. Red maple persistence decreased to 78% during 1977-87. Persistence of Oak ranged from 58 to 76% during 1927-37, decreased to 30 to 63% during 1957-67, and then increased gradually to 77 to 94% during 1977-87. Persistence of red and black oak was highest, and chestnut oak, lowest. During 1927-37 persistence of black and yellow birch was 73 and 71%, respectively; by 1977-87 it



increased to 81 and 84%. Beech persisted well, 77% during 1927-37 and 95% in 1967-77. White ash, on the other hand, persisted poorly; 60% in 1927-37, down to 53% in 1967-77, but increasing to 65% during the final decade, 1977-87. Intolerant pioneer species, such as bigtooth, quaking aspen and butternut, persisted poorly, and, as we have already seen, disappeared by 1977-87.

Minor species persisted poorly compared to Major species; 49% during 1927-37 and only 19% in 1977-87. The pioneer gray birch and redcedar completely disappeared from the sample. Chestnut also persisted poorly; 8% during 1927-37, increasing to 45% during 1957-67, and decreasing again to 9% during 1977-87. Chestnut blight permitted few stems to persist beyond a decade. Persistence of the tolerant dogwood was high through 1977. However, during 1977-87, dogwood persistence decreased to 13%, likely due to the same "dogwood blight" that attacked ornamental dogwood during the same decade. Persistence of blue-beech and hophornbeam varied from low to moderate during 1927-77, but during 1977-87 it increased dramatically to 69 and 82%, respectively.

Persistence of Major species differed little with site. Minor species persistence on the Dry site was clearly lower than on Moist or Medium Moist sites.

Persistence of basal area was greater than for stems (Table 11). Over all tracts and sites, persistence of basal area of Major species averaged 87% during 1927-37, dropped to 73% in 1937-57, and rose gradually to 91% during 1977-87. Clearly, large trees were persistent.

Among species groups, the proportion of persisting basal area increased slightly for Birch and Maple during 1927-87 (Fig. 9). Oak contributed the greatest proportion of persisting basal area, which remained nearly constant during 1937-87. Minor did not persist after 1967.

## GROWTH

Basal area at any point in time is the net effect of accretion on persisting stems, ingrowth and mortality, but the dynamics of change are concealed. Over time we note only whether it increases, decreases, or remains steady, but not how the final state is achieved. Accretion is the growth on trees that persisted throughout the period (Table 12). Ingrowth is the basal area of all trees that grew large enough to be measured by the end of the period. However, unless the number of new stems is great, ingrowth will be small because individual stems are small. Mortality is the basal area of stems previously measured that died during the period (Table 8). Loss of small stems deducts little from the sum of accretion and ingrowth, but loss of large trees causes a large deduction. If mortality exceeds accretion and ingrowth for the period, then negative growth results in a net loss of total basal area.

Over all tracts and sites, net basal area growth of Major species was positive for all decades except 1957-67, the decade of drought and first major defoliation. Minor species, on the other hand, had negative basal area growth in all decades except 1967-77, a time with increased ingrowth. On the Moist site Minor species had negative growth in all decades.

For the benefit of the reader, we show the components of growth of selected species in Table 13. Sugar maple had small, but positive, net growth in all decades and on all sites. Ingrowth was slight and mortality was low, thus accretion on persisting stems accounted for most of the change. For the more abundant red maple, net growth was positive for all decades and sites except the Moist site during 1937-57 when mortality was great. Close examination revealed that more than half the canopy red maple on the Moist site died during 1937-57, possibly due to windthrow during the 1938 hurricane.

All oaks had negative growth during 1957-67, with greater losses for white and chestnut oak than for others (Table 13). Basal area loss of white oak actually began during 1937-57 on the Medium Moist and Dry sites. For scarlet and chestnut oak, net loss of basal area continued into the next decade, 1967-77. For Oak, mortality of canopy trees accounted for all or nearly all of the mortality. Thus, the loss of large trees offset any gains through accretion and ingrowth.

On Moist and Medium Moist sites, yellow birch (Table 13), but not black birch, experienced loss of basal area during 1957-67. On the Moist site, the small loss of yellow birch basal area continued into the next decade, 1967-77.

Beech, like sugar maple, had positive basal area growth in each decade. Accretion steadily increased, ingrowth was small because the number of stems was small, and mortality was slight. White ash, on the other hand, was a species in decline. Only during 1927-37 did white ash experience positive basal area growth. On the Moist site, however, loss of white ash basal area occurred only during 1967-87. Tulip, despite relatively few stems, displayed high accretion on persisting stems. It maintained positive basal area growth throughout 1927-87.

Among Minor species, only flowering dogwood and chestnut maintained positive basal area growth during 1927-77. However, high mortality in 1977-87 caused net loss of basal area for these two species. All other Minor species had basal area loss throughout 1927-87.

## COMPOSITION OF THE CANOPY

The section entitled, "STAND DENSITY", counted all stems, large and small (Table 3). However, the character of the forest is really determined by the composition of the main canopy. Table 14 shows canopy composition by those trees with dominant or codominant crowns.

Dominant crowns project through the canopy and receive direct light from above and from the side. Codominant crowns make up the general level of the canopy and receive direct light from above and some from the side.

Over all tracts and sites, the proportion of Major species in the canopy ranged from 87% in 1927 to 100% by 1967 (Fig. 10). Minor species, because of their small stature or short life, would not be expected to remain in the canopy beyond an early stage of forest development. Canopy Maple, mostly red maple, increased from 14% of canopy in 1927 to 18% in 1987, but there was little change after 1967. Similarly, Birch increased from 16% in 1927 to nearly 22% in 1987, but there was little change after 1967. Oak increased from 37% in 1927 to 56% in 1957, decreased to 45% in 1967 and increased only slightly thereafter. Tulip increased steadily from 2.4% of the canopy in 1927 to 5.6% in 1987. The proportion of white ash in the canopy fluctuated over 60 years. Hickories declined markedly during 1927-87. Gray birch, a pioneer species, comprised 14% of the canopy in 1927, 4% in 1937 and none thereafter.

Although the same species that dominated total stand density also tended to dominate the canopy, their representation in the canopy was often different than in the total stand. For example, in 1927 Maple comprised 21% of the stand, but only 14% of the canopy. By 1987, Maple comprised 31% of the stand, but only 18% of the canopy. In 1927, Birch was 15% of the stand and 16% of the canopy. In 1987, it was 37% of the stand and 22% of the canopy. Although numerous, many Birch and Maple clearly did not participate in the canopy. On the other hand, in 1927 Oak comprised 20% of the total stand, but 37% of the canopy. In 1987 Oak was only 8% of the stand, but 47% of the canopy. Clearly, in 1987 most oaks were large and dominated the canopy far out of proportion to their numerical representation in the total stand.

On the Moist site, canopy participation of Maple increased almost steadily from 23% of stems in 1927 to 39% in 1987. Birch in the canopy increased from 14% in 1927 to 30% in 1967 and then remained nearly constant. Oak increased from 15% in 1927 to 26% in 1957, dropped to 18% in 1967 and remained steady thereafter.

On the Medium Moist site, Maple decreased from 12% in 1927 to 8% in 1957 and averaged 13% thereafter. Birch increased from 16% in 1927 to 24% in 1967 and remained at 23% during the last two decades. Oak increased from 41% in 1927 to 59% in 1957, declined to 48% in 1967, and rose to 51% by 1987. Hickory declined almost steadily from 5% of canopy participation in 1927 to 2% in 1987.

On the Dry site, Maple and Birch in the canopy generally declined over 60 years, but their participation was variable and limited almost exclusively to red maple and black birch. Oak rose from 45% in 1927 to 87% in

1957 and varied around 80% thereafter. Hickory variably decreased from 6 to 1%. Although Oak was abundant in the main canopy on all sites, it was clearly more abundant with decreased soil moisture. Birch and Maple in the canopy clearly decreased with increasing dryness.

Unlike stand density of trees in the canopy, basal area of canopy trees increased throughout 1927-87 (Table 15). Over all tracts and sites, canopy basal area of Major species, as a percent of Major species total basal area, was 67% in 1927, decreased slightly to 64% in 1937, rose to 79% in 1967, and then declined to 71% in 1987. The pattern of change was similar for all sites, but the proportion of basal area in the canopy was greatest on Medium Moist and least on Dry.

Oak dominated canopy basal area and the proportion changed little after 1957 (Fig. 11). The proportion contributed by other species groups also remained relatively constant after 1957.

Comparison of Tables 6 and 15 indicates that in 1927 about 40% of Maple basal area was in the canopy. Participation increased to 43% in 1937, decreased to 39% in 1957, rose to 48% in 1967, and declined to 43% in 1987. In 1927, Birch basal area in the canopy was 56% of total Birch basal area, increased to 65% in 1967, and decreased to 43% by 1987. In recent decades, subcanopy Maple and Birch comprised an increasing proportion of basal area. On the other hand, in 1927, 84% of Oak basal area was already on stems in the canopy. By 1937, the proportion in the canopy decreased to 77%, increased to 97% in 1967, and then remained constant. From the beginning, nearly all large oaks were in the canopy where they persisted.

In 1927, basal area of Minor in the canopy was only 34% of total Minor basal area. Thereafter, there was almost no participation of Minor in the canopy.

## CANOPY DYNAMICS

The stand canopy is dynamic; some trees die, others lag behind and become overtopped, while others enter the canopy through gaps. Except in very young stands, trees that enter or leave the canopy are large, otherwise they would not be in the canopy. Therefore, canopy mortality (Table 16, 18) and ingrowth (Table 17, 19), especially when expressed as basal area (Tables 18, 19), will have a greater relative impact on the canopy than would mortality and ingrowth for the entire stand.

Over all tracts and sites, canopy mortality of Major species in 1927-37 was 23% of canopy basal area and 35% of canopy density. Clearly, most of the mortality was from small stems. During the double decade, 1937-57, mortality removed 28% of canopy basal area and 45% of stems, a clear decrease in the 10-year mortality. During 1957-67, canopy basal area mortality increased to 19%, and included 16% of stems, an indication that larger stems in

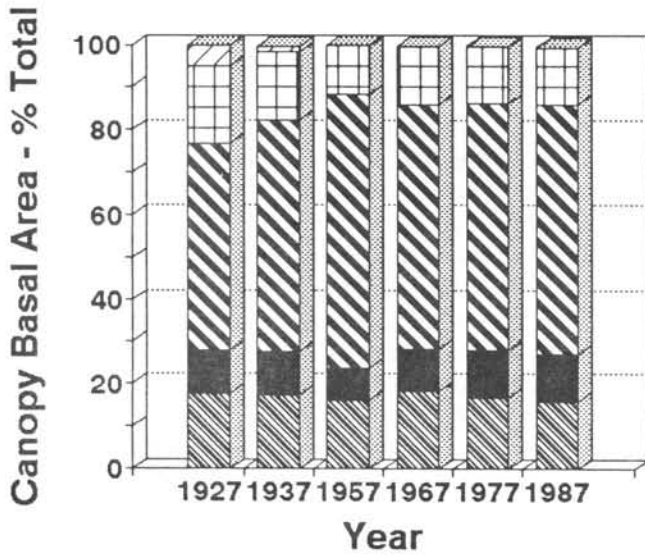
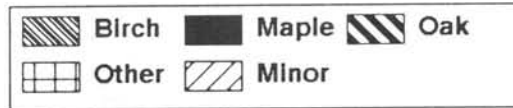


Figure 11. Percentage of canopy basal area contributed by species groups during 1927-87. Average over all tracts and sites.

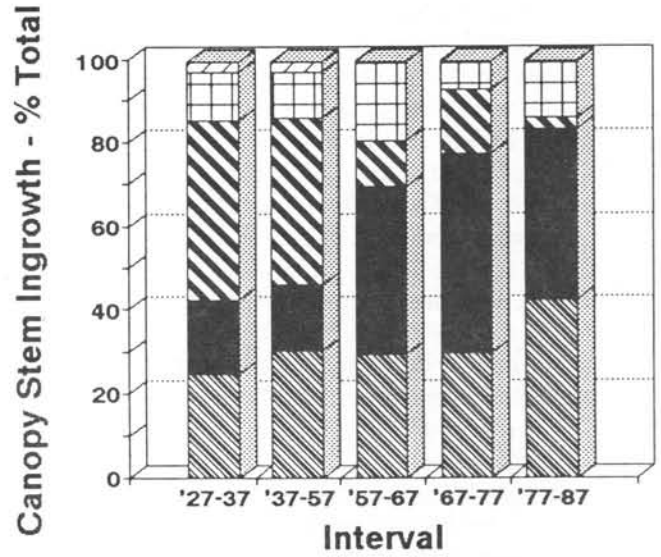


Figure 13. Percentage of periodic canopy stem ingrowth contributed by species groups during 1927-87. Average over all tracts and sites.

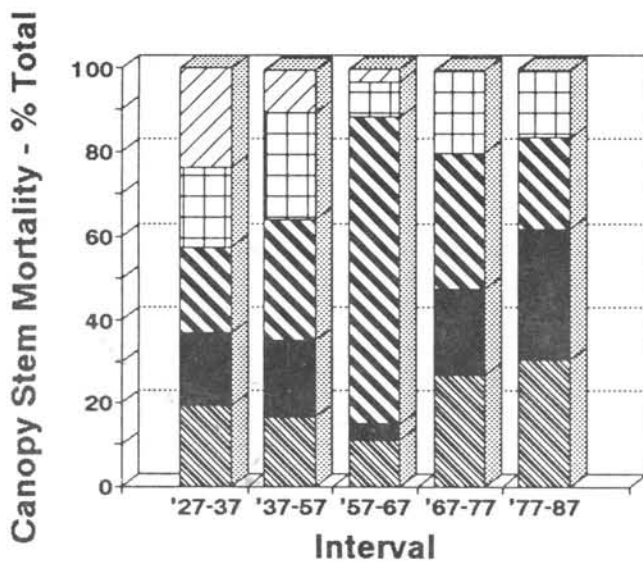


Figure 12. Percentage of periodic canopy stem mortality contributed by species groups during 1927-87. Average over all tracts and sites.

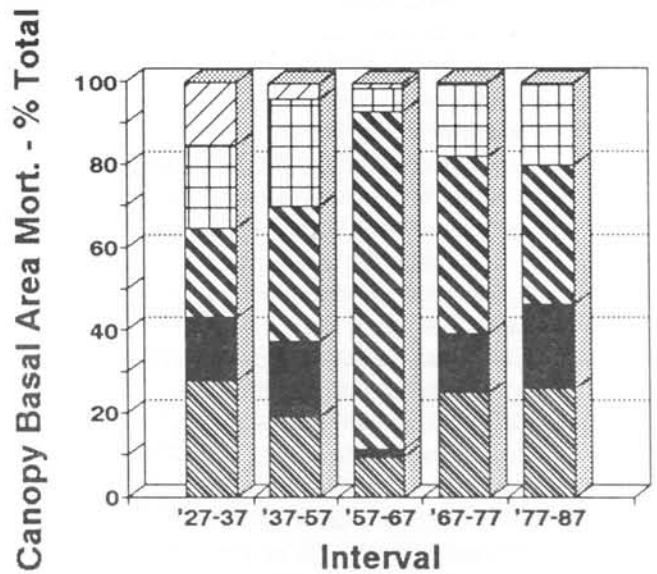


Figure 14. Percentage of periodic canopy basal area mortality contributed by species groups during 1927-87. Average over all tracts and sites.



the canopy were dying. Canopy mortality remained high during 1967-77, 18% of basal area and 28% of stems, but canopy mortality was largely among the smaller stems. During the final decade, 1977-87, mortality decreased to 13% of basal area and 19% of stems.

The contribution of species groups to canopy mortality (Fig. 12, 14) and ingrowth (Fig. 13, 15) varied during 1927-87. The proportion of Oak mortality was greatest during 1957-67 and least for Birch and Maple (Fig. 12, 14). Subsequently, the proportion of Oak mortality decreased while Birch, Maple and Other generally increased.

Birch mortality decreased from 40% of canopy basal area and 50% of canopy stems in 1927-37 to 12% of basal area and 14% of stems by 1957-67. During 1967-77, Birch mortality increased to 25% of basal area and 31% of stems. In 1977-87, Birch mortality again decreased to 19% of basal area and 27% of stems.

Maple mortality followed a similar pattern. In 1927-37 Maple canopy mortality was 39% of basal area and 53% of stems; it decreased to 5% of basal area and 33% of stems by 1957-67, mostly a loss of small canopy stems. In 1967-77, mortality increased to 25% of basal area, but decreased to 20% of stems. Much larger maples were dying than previously. Although the proportion of Maple canopy basal area mortality remained nearly unchanged in 1977-87, stem mortality decreased to 9%. Canopy mortality consisted of a few large trees.

Oak canopy mortality had a different pattern. During 1927-37 Oak canopy mortality was 12% of basal area and 22% of stems. Many small canopy oaks died. By 1957-67, mortality increased to 25% of basal area and 32% of stems. More of the larger oaks were lost from the canopy. By 1977-87, mortality declined to 7% of basal area and 9% of stems. This was the lowest proportion of any species group in the canopy. Clearly, Oak suffered higher losses in the canopy during 1957-67, but less thereafter. Canopy mortality of Birch and Maple was greater than Oak during the last two decades, 1967-87.

Over all tracts and sites, ingrowth of Major species into the canopy, expressed as a percent of stems present at the end of an interval, was about 6% after 1937. However, when expressed as a percent of basal area present at the end of an interval, canopy ingrowth of Major species decreased slightly from 4.3% in 1927-37 to 3.6% in 1977-87. As trees in the canopy grew large, additions by ingrowth were relatively less. On the Medium Moist site, canopy ingrowth changed little after 1967. On the Moist site, canopy ingrowth was least during 1967-77, whereas it was greatest on the Dry site during that same period.

## FIRE

In "METHODS" we indicated that a late summer fire in 1932 burned about a third of the Turkey Hill tract on all

sites except Wet. The effects of the fire through 1987 have been reported (Ward and Stephens 1989), but we summarize the basic information here. In 1926 the portion of Turkey Hill tract that subsequently burned in 1932 was similar in composition to the other tracts. There were 22 Major and 6 Minor species (Table 20). In 1934, after the fire, 16 Major and 1 Minor species remained. Black ash, basswood and redcedar were eliminated from the burned sample. Mockernut hickory, bigtooth aspen, butternut, black cherry, sassafras, blue-beech, shadbush, hophornbeam, and gray birch were absent from the 1934 inventory, but reappeared by 1957. White pine, bitternut hickory, American elm, and chestnut appeared in the inventory for the first time in 1957. In 1987, there were 21 Major and five Minor species, similar to the composition of the other unburned tracts (Table 3).

In 1926, prior to the fire, Minor, Oak and Other comprised about three-fourths of stand density (Fig. 16). After the fire, Birch, Maple and Oak dominated the survivors in 1934. Thereafter, the proportion of Birch and Maple steadily increased while Oak, Other and Minor decreased.

Over all sites, stand density of Major species decreased nearly 80% during 1926-34, but nearly doubled the 1926 density by 1957 (Table 20). This pattern prevailed among most Major species. Fire reduced Minor species to less than 1% of 1926 stand density, but by 1957 density of Minor had recovered to approximately the 1926 level. Flowering dogwood increased to about 150% of its 1926 density: other Minor species failed to recover to their 1926 density.

Among the sites, loss of Major species due to fire and subsequent regrowth was less on the Moist site than on Medium Moist or Dry sites. No Minor species were inventoried in 1934 on the Moist or Dry sites. Blue-beech dominated Minor on the Moist site in 1957. On the Medium Moist and Dry sites flowering dogwood was the dominant Minor species in 1957.

In 1926, the burned portion of the Turkey Hill tract (Table 21) had about a third fewer stems than the other tracts (Table 5). There were fewer saplings but more sawtimber than on the other tracts. The fire killed mostly small diameter stems. In 1934, over all sites, about 95% of stems less than 2.5 in. dbh were dead (Table 22). The next two larger diameter classes had 75 and 62% loss. By 1934, no trees larger than 12.5 in. dbh died. However, during 1934-57 there was increased mortality among the larger diameter classes. In 1957, 25 years after the fire, there was a marked increase in stems less than 4.6 in. dbh (Table 21), which originated as sprouts or seedlings. After 1957, the population of small stems declined. Some grew to larger classes; most apparently succumbed to competition.

The contribution of species groups to basal area was remarkably similar over time, except for 1934 (Fig. 17).

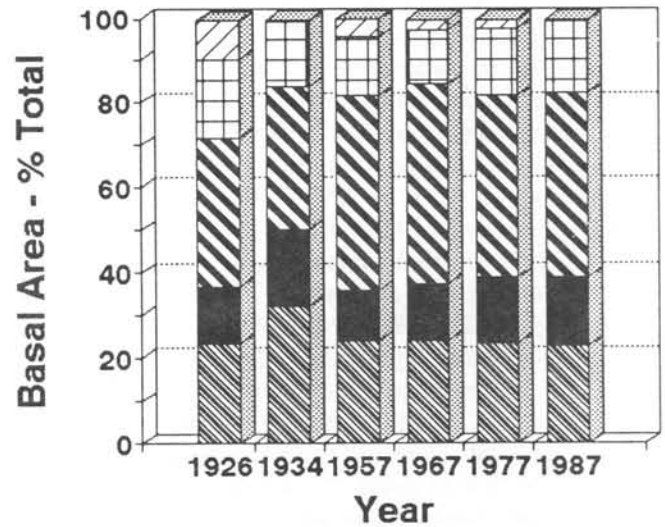
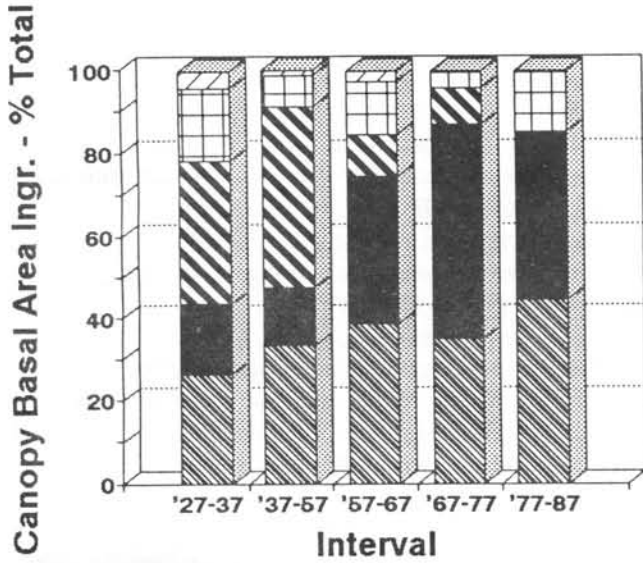
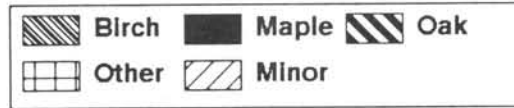


Figure 15. Percentage of canopy basal area ingrowth contributed by species groups during 1927-87. Average over all tracts and sites.

Figure 17. Percentage of stand basal area contributed by species groups on the burned portion of Turkey Hill tract during 1926-87. Fire occurred in 1932. Average over all sites.

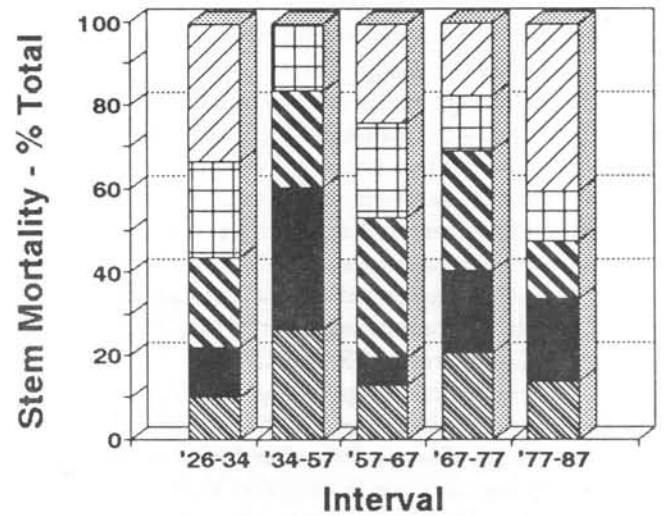
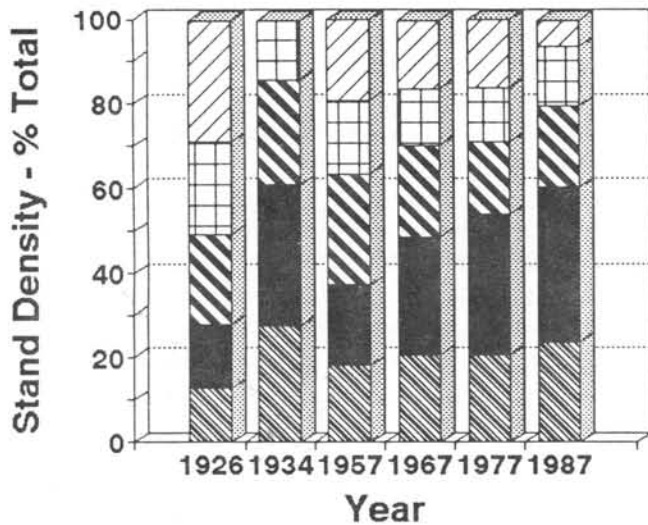


Figure 16. Percentage of stand density contributed by species groups on the burned portion of Turkey Hill tract during 1926-87. Fire occurred in 1932. Average over all sites.

Figure 18. Percentage of periodic stem mortality contributed by species groups on the burned portion of Turkey Hill tract during 1926-87. Fire occurred in 1932. Average over all sites.



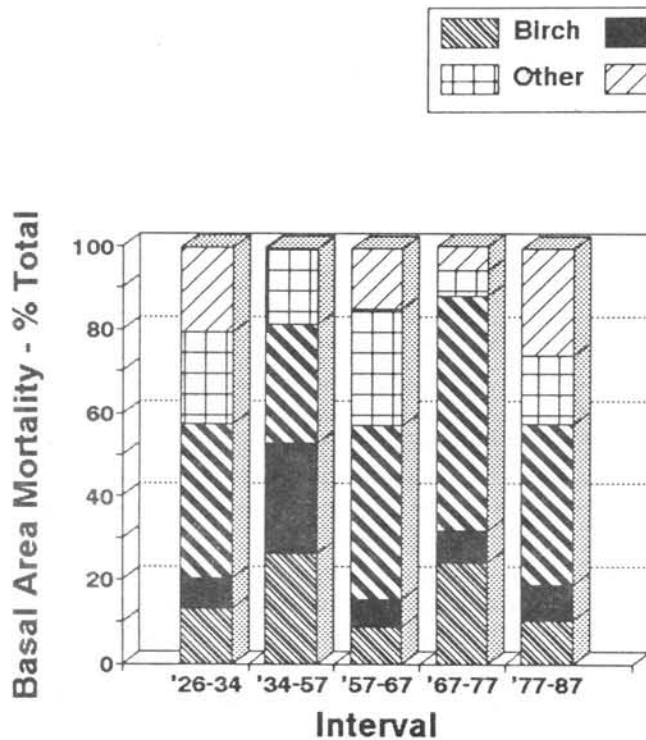


Figure 19. Percentage of periodic basal area mortality contributed by species groups on the burned portion of Turkey Hill tract during 1926-87. Fire occurred in 1932. Average over all sites.

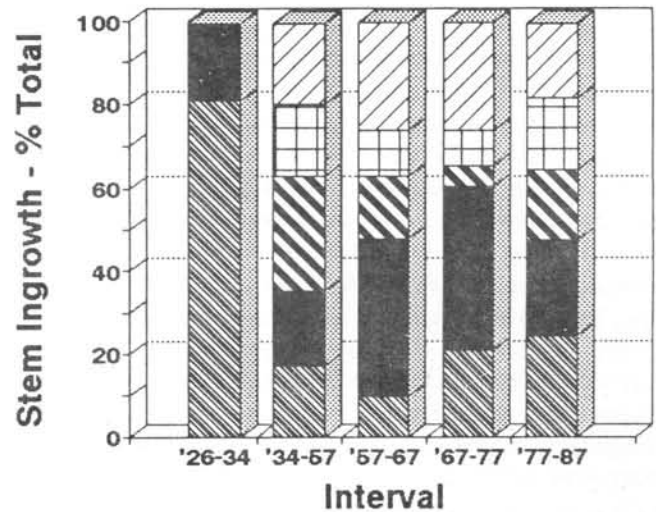


Figure 20. Percentage of periodic stem ingrowth contributed by species groups on the burned portion of Turkey Hill tract during 1926-87. Fire occurred in 1932. Average over all sites.

Minor gradually disappeared, whereas the remaining species groups remained nearly constant.

Over all sites, basal area decreased by a third after the fire (Table 23) because mostly small diameter stems were killed. On the Moist site, basal area of Major species actually increased during 1926-34. On the Medium Moist site, basal area decreased about 40%; on the Dry, about two-thirds. Basal area of Minor was eliminated in 1934 on all sites except Medium Moist. Although Minor basal area increased on all sites by 1957, it declined thereafter.

The proportion of species groups in mortality was variable during 1926-87, but showed a similar pattern for both stem and basal area mortality (Fig. 18, 19). Minor, Other and Oak contributed about 80% of both stem and basal area mortality during 1926-34. On the other hand, Birch, Maple and Oak accounted for about 80% of stem and basal mortality in 1934-57. During 1957-87, the proportion of Oak in basal area mortality was much greater than its proportion of stem mortality; the opposite was true for Maple. Small maples but large oaks died.

Over all sites, periodic ingrowth of Major species was great during 1934-57 (Table 24), but low thereafter. After 1957, ingrowth was much lower on the burned tract compared to the unburned tracts. During 1957-87,

ingrowth on the burned tract was comparable to that on the unburned tracts during 1927-57 (Table 9).

During 1926-34, ingrowth was 80% Birch and 20% Maple (Fig. 20). During 1934-77, Oak and Other ingrowth gradually decreased; ingrowth of the remaining species groups increased. In the last decade, 1977-87, ingrowth of Oak and Other increased, Maple and Minor decreased, and Birch remained nearly unchanged.

Fire drastically reduced stand density and diversity temporarily by eliminating small diameter stems and several species. However, the longer term effect was only to retard stand development about 30 years. The burned tract was left with the curious mixture of larger stems typical of a more mature forest and an abundance of smaller diameter stems usually found in a young forest.

#### FUTURE FOREST

Our historical record since 1927 shows that in the early decades pioneer and Minor species disappeared, first from the canopy (Table 14) and, finally, from the sample (Table 3). Oak increasingly dominated the tracts in basal area (Table 6) and participation in the canopy (Table 15). During a middle decade, 1957-67, with drought and

repeated defoliation, there was great Oak mortality (Tables 8, 16) and a marked increase in Maple and Birch density and basal area (Tables 14, 15). Succeeding decades experienced defoliation, but not drought. Oak mortality diminished and ingrowth of Birch and Maple decreased. The remaining oaks have grown large, and there are few small oaks. Few new trees grew into the canopy. Clearly, the oak-dominated canopy cannot persist indefinitely. What kind of forest will replace the present one?

Stephens and Waggoner (1970, 1980) used transition probabilities to summarize changes in the forest over time and to anticipate what the forest might become. The transects were divided into 1-chain (66 ft) intervals to provide a series of fortieth-acre plots. All plots with fire or other non-natural disturbance were excluded and the remainder were further subdivided according to their moisture class. This yielded 364 undisturbed fortieth-acre plots, but only the Medium Moist site had enough for reliable analysis, 253. The stems that grew upon the plots were subdivided into five species groups: Oak, Birch, Maple, Other major species, and Minor species. For each inventory, each plot was classified according to the species group with the greatest number of stems. This permitted construction of a series of matrices, one for each interval, showing the probability of plots remaining in the same species group as at the beginning of the interval or becoming dominated by a different species group. We show the matrix of transition probabilities for each 10- or 20-year interval in Table 25.

The 1927-37 transitions indicated that most plots tended to remain as they were at the beginning of the interval. This is shown by the high probabilities in the diagonal from upper left to lower right. The off-diagonal elements of the matrix of probabilities indicate the transitions to other states. The transition probabilities of the 20-year interval, 1937-57, cannot be directly compared with those of the 10-year intervals because they combine the results of two 10-year transitions. However, the outcome of two successive 10-year transitions should estimate the 20-year change (Table 26). The two matrices are not identical, but they are similar. The persistence of Oak was overestimated and the persistence of Maple, Other and Minor was underestimated by the transition probabilities.

In the 1957-67 and 1967-77 transitions, persistence of Oak decreased markedly. We already know that in the decade of drought and defoliation (1957-67) Oak mortality was great (Table 7). After 1967 the persistence of Oak greatly increased, but the number of plots dominated by Oak was too small to yield reliable transitions. Persistence of Maple and Birch first decreased and then increased. Plots dominated by Other major species increased slightly, whereas those classified Minor continued to decrease. This is no surprise; we already know that Minor species

density had been decreasing since 1927 (Table 3).

In this classification all stems received equal weight, regardless of size. Loss of small stems could alter the classification, although from a distance the plot might appear unchanged. Therefore, the transitions were determined from species groups based on dominant and codominant trees in the canopy (Table 27). For those plots with no dominant or codominant trees, a new class, Empty, was introduced. In such plots canopy was contributed by stems located outside the plot boundaries.

Again, the diagonal elements indicated high persistence of all classes except Minor. By 1957, no plots were dominated by Minor. Plots classified as Empty gradually increased, but there was change to and from the Empty state. These transitions, based only on trees in the upper canopy, were far more constant than those derived from all stems. We have already noted that persistence of canopy trees was great (Table 16).

Another classification, stocking (Gingrich 1967), utilized number of stems, stem diameter and basal area. Plot classification was determined by the species group with greatest stocking (Table 28). Again, the diagonal elements showed marked persistence for each class and the transitions from decade to decade were similar.

If the transitions are constant from decade to decade, they are stationary. If the transition probabilities are independent of antecedent, that is, if the transitions depend only on the present state, but not how it got to the present state, the matrix of transition probabilities resembles a Markov chain. A stationary Markov chain has convenient mathematical properties (Feller 1950).

One property allows the estimation of the probability of change over a longer period from the transition probabilities of a shorter period. Multiplying a matrix of transition probabilities for a decade by itself according to the rules of matrix algebra yields the transition probabilities for a period of two decades. This would allow comparison of the 20-year transition probabilities of 1937-57 with an estimate derived from an earlier (Table 26) or later decade.

Another useful property permits the equilibrium or steady state to be calculated; that is, when the number of plots leaving a state is matched by a like number entering the state from other states so that there is no change in the distribution among states.

Table 25 indicates that the transition probabilities based on total number of stems are not constant for these data. Indeed, Binkley (1980) showed that earlier transitions based on stem number (Stephens and Waggoner 1970) were not constant over time. Stephens and Waggoner (1980) spoke of the classification process: "Finally, good fortune must attend this process, since the constancy of the probabilities depends upon the skill of classification." The transition probabilities based on

canopy density (Table 27) and stocking level (Table 28) were more constant over time than those based only on number of stems (Table 25). As a check on the stationarity of the transitions, the transitions of 1927-37 for upper canopy trees and stocking level were used to estimate the number of plots in each species group for 1957 and 1987. The estimated number of plots was compared to the observed number and subjected to chi-square analysis (Table 29). The 1927-37 transitions based on canopy density did not predict well the distribution among species groups in 1957 and 1987. Oak and Minor were overestimated and the remainder, underestimated. The predicted distribution among species groups differed significantly from the observed distribution. On the other hand, the 1927-37 transitions based on stand stocking level did predict well the distribution among states in 1957, but not 1987 (Table 29).

However, we know that there was a strong disturbance during 1957-67 in the form of drought and repeated defoliation. This combination did not occur earlier in the life of the stand, nor has it occurred since. We also know that it affected Oak primarily. Therefore, the transitions for 1967-77 based on canopy trees or stocking level were used to predict the number of plots in each species group in 1987. The predicted values were compared with the observed values for 1987 (Table 30). The values of chi-square were small, indicating that the observations did not differ significantly from the prediction. Plots dominated by Oak were slightly underestimated and by Maple, slightly overestimated. Although the transitions were not stationary over 60 years, they were stationary for two recent decades.

The steady states estimated from the transition probabilities of Table 27 are shown in Table 31. The predicted steady states do vary. Those calculated from the transitions of the early decades indicate a high proportion of Oak; the steady states calculated from the decade of drought and defoliation, 1957-67, and thereafter, indicate a much lower proportion of Oak in the equilibrium forest. Nevertheless, in every case there was more Oak than any other species group.

The increasing number of plots classified as Empty is likely the effect of plot dimension, 16.5 x 66 ft. As tree crowns grew large, fewer could fit in a plot. The crown width of a large tree is easily greater than plot width; hence, it is easy to see why, over time, there are more plots whose upper canopy was contributed by trees outside the plot.

Attainment of the steady state may take infinite time. However, the time to steady state may be estimated by the time required to reach some reasonable approximation of steady state, say within 1% of the steady state value for each class. Note that the estimated time ranged from two to four centuries (Table 31). These estimates do not seem

unreasonable, given what we know about longevity of Connecticut forests (Nichols 1913).

As indicated earlier, an important criterion of a Markov chain is independence of antecedent, that is, the transition probabilities for a state depend only on the present state, not on how it arrived at that state. Therefore, the plots on Medium Moist site were classified by species group in 1927 according to the number of dominant and codominant stems (Table 27, 1927-37 matrix). The classification yielded 137 Oak plots, 41 Birch, 13 Maple, 40 Other, 17 Minor, and five Empty. Only Oak, Birch and Other had a sufficient number of plots for analysis. Unfortunately, the number of plots transforming to other states during 1927-37 was small. Therefore, some of the subsequent transformations may be unreliable.

Transition probabilities for 1977-87 are shown in Table 32. The persistence of Oak was great in all transitions derived from the three antecedent states. However, the number of plots in some other states was too small for reliable transitions. For example, in the 1977-87 transitions derived from plots classified Oak or Birch in 1927, Other became an absorbing state; that is, there were pathways to Other from remaining states, but there were no pathways from Other to remaining states. Similarly, in the 1977-87 transitions derived from plots originally Other in 1927, Maple became an absorbing state. In each case the number of plots classified Other or Maple was small. Unfortunately, independence of antecedent cannot be clearly proven.

Thus, transition probabilities remain a useful summary of change in the forest over time, and with the correct classification, may even predict short term change. However, reliable long term prediction of the future forest requires a model that can accommodate drastic change induced by drought, defoliation or other major natural disturbances.

#### LITERATURE CITED

- Anonymous, 1951. Soil survey manual. U.S.D.A., Agr. Handbook 18. 503 p.
- Binkley, C.S. 1980. Is succession in hardwood forests a stationary Markov process? *For. Sci.* 26:566-570.
- Collins, S. 1961. Three decades of change in an unmanaged Connecticut woodland. *The Conn. Agr. Expt. Sta., New Haven. Bull.* 653. 32 p.
- Dickson, D.R. and C.L. McAfee, 1988. Forest statistics for Connecticut--1972 and 1985. U.S.D.A. For. Svc., North-eastern For. Expt. Sta., Resource Bull. NE-105. 102 p.
- Harper, R.M. 1918. Changes in the forest area of New England in three centuries. *J. Forestry* 16:442-452.

Hicock, H.W., M.F. Morgan, H.J. Lutz, H. Bull, and H.A. Lunt. 1931. The relation of forest composition and rate of growth to certain soil characters. The Conn. Agr. Expt. Sta., New Haven. Bull. 330. 73 p.

Little, E.L., Jr. 1979. Check list of United States trees (Native and naturalized). U.S.D.A. Agr. Handbook 541. 375 p.

Nichols, G.E. 1913. The vegetation of Connecticut. II. Virgin forests. *Torreyia* 13:199-215.

Olson, A.R. 1965. Natural changes in some Connecticut woodlands during 30 years. The Conn. Agr. Expt. Sta., New Haven. Bull. 699. 52 p.

Stephens, G.R. and P.E. Waggoner. 1970. The forest anticipated from 40 years of natural transitions in mixed hardwoods. The Conn. Agr. Expt. Sta., New Haven. Bull. 707. 58 p.

Stephens, G.R. and P.E. Waggoner. 1980. A Half century of natural transitions in mixed hardwood forests. The Conn. Agr. Expt. Sta., New Haven. Bull. 783. 44 p.

Ward, J.S. and G.R. Parker. 1987. Fifty-five years of association and diversity dynamics in an old-growth forest in Indiana: Davis-Purdue Research Forest 1926-1981. In Proc. Central Hardwood Forest Conference VI. Knoxville, TN. Feb. 24-26, 1987. p. 369-376.

Ward, J.S. and G.R. Stephens. 1989. Long-term effects of a 1932 surface fire on stand structure in a Connecticut mixed hardwood forest. In Proc. Seventh Central Hardwood Forest Conference. Carbondale, IL. Mar. 5-8, 1989. p. 267-273.

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## COMMON AND SCIENTIFIC NAMES OF TREES MENTIONED IN THIS BULLETIN

Ash, black	<i>Fraxinus nigra</i> Marsh.
white	<i>F. americana</i> L.
Aspen, bigtooth	<i>Populus grandidentata</i> Michx.
quaking	<i>P. tremuloides</i> Michx.
Basswood	<i>Tilia americana</i> L.
Beech <sup>1</sup>	<i>Fagus grandifolia</i> Ehrh.
Birch, black <sup>1</sup>	<i>Betula lenta</i> L.
gray	<i>B. populifolia</i> Marsh.
paper	<i>B. papyrifera</i> Marsh.
yellow	<i>B. alleghaniensis</i> Britton
Blue-beech <sup>1</sup>	<i>Carpinus caroliniana</i> Walt.
Butternut	<i>Juglans cinerea</i> L.
Cherry, black	<i>Prunus serotina</i> Ehrh.
Chestnut <sup>1</sup>	<i>Castanea dentata</i> (Marsh.) Borkh.
Dogwood, flowering	<i>Cornus florida</i> L.
Elm, American	<i>Ulmus americana</i> L.
Hemlock	<i>Tsuga canadensis</i> (L.) Carr.
Hickory, bitternut	<i>Carya cordiformis</i> (Wangenh.) K. Koch
mockernut	<i>Carya tomentosa</i> (Poir.) Nutt.
pignut	<i>C. glabra</i> (Mill.) Sweet
shagbark	<i>C. ovata</i> (Mill.) K. Koch
Hophornbeam <sup>1</sup>	<i>Ostrya virginiana</i> (Mill.) K. Koch
Locust, black	<i>Robinia pseudoacacia</i> L.
Maple, red	<i>Acer rubrum</i> L.
sugar	<i>A. saccharum</i> Marsh.
Oak, black	<i>Quercus velutina</i> Lam.
chestnut	<i>Q. prinus</i> L.
red <sup>1</sup>	<i>Q. rubra</i> L.
scarlet	<i>Q. coccinea</i> Meunchh.
white	<i>Q. alba</i> L.
Pepperidge <sup>1</sup>	<i>Nyssa sylvatica</i> Marsh.
Pine, white <sup>1</sup>	<i>Pinus strobus</i> L.
Redcedar <sup>1</sup>	<i>Juniperus virginiana</i> L.
Sassafras	<i>Sassafras albidum</i> (Nutt.) Nees
Shadbush <sup>1</sup>	<i>Amelanchier arborea</i> (Michx. f.) Fern.
Tulip <sup>1</sup>	<i>Liriodendron tulipifera</i> L.

<sup>1</sup> Local name differing from Little (1979)



Table 6a. Basal area (ft<sup>2</sup>/A) during 1927-87. Average over all tracts. All sites includes wet. T represents less than 0.1 ft<sup>2</sup>/A. N indicates no stems present.

SPECIES	All Sites						Moist					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	1.2	1.5	1.9	2.2	2.8	3.5	4.0	4.5	5.5	6.2	7.8	9.3
Red maple	10.2	11.9	11.6	13.1	14.9	16.7	21.8	24.4	22.3	23.3	23.3	27.4
Bitternut hickory	T	T	T	T	T	T	T	T	N	N	T	T
Mockernut hickory	.6	.7	.8	.5	T	.1	T	T	T	T	T	.1
Pignut hickory	1.5	1.7	1.7	1.7	.5	.5	.3	.4	.5	T	T	T
Shagbark hickory	.6	.8	.9	.7	.4	.5	.7	.9	1.5	1.3	1.4	1.6
Northern red oak	8.4	13.3	20.4	20.3	20.8	24.1	6.2	10.8	19.2	18.1	17.4	20.5
Black oak	3.2	5.4	8.7	8.3	9.1	9.9	1.5	2.0	2.6	2.6	3.0	3.2
Scarlet oak	3.3	5.0	7.2	6.3	6.0	5.9	1.5	2.8	3.5	1.9	2.2	2.6
White oak	6.2	8.0	7.7	4.1	4.1	4.4	1.6	2.2	2.4	1.5	1.6	1.9
Chestnut oak	4.6	6.4	7.8	3.2	2.6	2.7	2.9	4.6	6.1	2.7	.7	T
Yellow birch	5.4	6.7	6.8	6.5	7.4	9.4	13.5	16.0	18.3	17.9	17.7	20.7
Black birch	8.8	10.6	12.2	13.3	15.4	16.9	9.3	8.0	11.0	12.3	13.5	15.0
Paper birch	T	.1	.1	.1	T	N	N	N	N	N	N	N
Beech	.2	.3	.6	.9	1.7	2.9	.1	.3	.8	1.1	1.7	2.5
White ash	2.8	3.3	2.7	2.7	2.4	2.3	4.2	5.2	5.4	5.5	5.3	4.2
Black ash	T	T	T	T	T	T	.5	.4	T	T	T	T
Basswood	.2	.3	.2	.1	.1	.1	.5	.7	.2	N	N	N
Tulip	1.8	2.8	3.5	4.5	6.1	7.5	2.3	3.6	4.8	5.9	7.9	8.5
American elm	.4	.4	.4	.2	T	T	1.8	1.9	1.9	.8	T	T
Bigtooth aspen	1.9	1.8	T	T	N	N	4.9	4.6	N	N	N	N
Quaking aspen	T	T	N	N	N	N	T	T	N	N	N	N
Tupelo	.2	.2	.2	.2	.3	.4	.3	.4	.3	.5	.8	1.3
Black locust	T	T	T	T	T	T	N	N	N	N	N	N
Butternut	.3	.1	N	N	T	N	.3	T	N	N	N	N
Black cherry	.3	T	T	N	T	T	.8	.2	T	N	N	N
Sassafras	.3	.4	.3	.2	.2	.3	.4	.2	.2	.1	T	.1
White pine	T	T	T	N	T	T	N	T	N	N	N	N
Hemlock	T	T	T	T	.1	.1	T	T	T	.1	.2	.3
MAJOR SPECIES	62.8	82.1	96.2	89.4	95.3	108.5	79.6	94.3	106.6	102.0	104.7	119.5
Chestnut	T	T	.2	.2	.4	T	T	T	T	T	.1	T
Flowering dogwood	.6	.7	.7	.7	.8	.2	.2	.2	.3	.4	.6	.3
Blue-beech	1.8	1.4	.8	.3	.1	.1	3.0	2.6	2.1	.7	.2	.3
Shadbush	.2	.2	T	T	T	T	.3	.4	T	T	T	T
Hophornbeam	.6	.6	.4	T	T	T	1.1	1.0	.8	T	T	T
Gray birch	2.9	2.1	T	T	T	N	4.2	2.8	.2	N	N	N
Redcedar	.2	T	T	N	N	N	N	N	N	N	N	N
MINOR SPECIES	6.5	5.0	2.2	1.3	1.4	.5	8.8	7.1	3.6	1.3	1.0	.7
ALL SPECIES	69.3	87.1	98.5	90.7	96.7	109.0	88.5	101.4	110.2	103.3	105.6	120.2

Table 6b. Basal area (ft<sup>2</sup>/A) during 1927-87. Average over all tracts. All sites includes wet. T represents less than 0.1 ft<sup>2</sup>/A. N indicates no stems present.

SPECIES	Medium Moist						Dry					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	.9	1.1	1.5	1.7	2.2	2.8	.1	.2	.2	.2	.5	.7
Red maple	7.7	9.3	9.7	11.1	13.3	14.3	5.8	6.8	6.8	8.2	10.1	12.0
Bitternut hickory	T	T	T	T	T	T	N	N	N	N	N	N
Mockernut hickory	.7	.8	1.0	.6	.1	.1	.7	.9	.9	.8	T	T
Pignut hickory	1.5	1.7	1.9	2.0	.6	.7	2.7	3.5	2.8	2.5	.9	.6
Shagbark hickory	.7	.9	.9	.7	.3	.3	.2	.2	.2	N	N	N
Northern red oak	9.9	15.3	22.7	22.3	22.9	26.3	4.9	8.9	14.5	16.4	17.8	21.5
Black oak	3.2	5.3	8.6	8.2	9.3	10.0	6.2	11.0	18.0	16.8	16.6	19.4
Scarlet oak	3.7	5.2	7.5	6.6	5.8	5.5	4.1	7.1	11.5	11.0	12.3	12.4
White oak	7.1	8.7	8.3	4.5	4.4	4.7	8.3	12.5	12.4	5.9	6.1	6.1
Chestnut oak	5.7	8.0	9.4	3.5	3.1	3.3	2.1	2.3	3.3	3.2	3.2	3.9
Yellow birch	4.6	5.9	5.5	5.1	6.4	8.7	.6	.6	.6	.6	.8	1.0
Black birch	9.4	11.8	12.9	13.9	15.8	17.6	7.1	9.8	12.1	14.2	18.0	18.5
Paper birch	.1	.2	.2	.2	.1	N	N	N	N	N	N	N
Beech	.2	.3	.5	.8	1.6	2.9	.4	.6	.8	1.3	2.4	4.1
White ash	2.9	3.4	2.6	2.5	2.1	2.0	1.1	1.4	.3	.1	N	N
Black ash	T	T	N	N	T	T	N	N	N	T	N	N
Basswood	.2	.3	.3	.2	.2	.2	N	N	N	N	N	N
Tulip	2.2	3.3	4.0	5.1	6.9	8.8	.1	.2	.4	.6	1.0	1.4
American elm	T	T	T	T	T	T	T	N	N	N	N	N
Bigtooth aspen	1.3	1.4	.1	T	N	N	1.5	1.1	N	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N	N	N
Tupelo	.1	.2	.2	.2	.2	.3	T	T	T	T	T	T
Black locust	N	N	N	N	N	N	T	T	.2	.3	.4	.5
Butternut	.3	.1	N	N	T	N	.2	.1	N	N	N	N
Black cherry	.1	T	N	N	T	T	.3	T	N	N	N	N
Sassafras	.3	.5	.4	.2	.2	.3	.3	.1	.1	.2	.3	.4
White pine	.1	.1	T	N	T	T	N	N	N	N	N	T
Hemlock	T	T	T	T	.1	.1	N	N	N	N	N	N
MAJOR SPECIES	63.2	83.8	98.3	89.6	95.9	108.9	46.4	67.2	85.2	82.3	90.4	102.6
Chestnut	T	T	.2	.3	.4	.1	.2	T	.2	.3	.6	T
Flowering dogwood	.8	.9	.9	.9	1.0	.2	.3	.3	.2	.2	.2	T
Blue-beech	1.8	1.3	.7	.2	.1	.1	.7	.3	.1	T	T	T
Shadbush	.2	.2	T	T	T	T	.2	.3	.1	.2	T	N
Hophornbeam	.6	.5	.4	T	T	T	.3	.3	.2	T	T	T
Gray birch	2.9	2.1	T	T	N	N	2.3	1.6	N	N	T	N
Redcedar	.3	T	T	N	N	N	.2	N	N	N	N	N
MINOR SPECIES	6.6	5.1	2.2	1.4	1.6	.5	4.1	2.8	.9	.7	.9	.1
ALL SPECIES	69.8	88.9	100.6	91.0	97.5	109.4	50.5	70.1	86.0	82.9	91.3	102.7

Table 7a. Periodic mortality (stems/A) during 1927-87. Average over all tracts. All sites includes wet.  
N indicates no stems present.

SPECIES	All Sites					Moist				
	1927	1937	1957	1967	1977	1927	1937	1957	1967	1977
	-1937	-1957	-1967	-1977	-1987	-1937	-1957	-1967	-1977	-1987
Sugar maple	6.6	11.4	5.1	4.3	3.6	9.8	27.0	11.0	10.4	6.1
Red maple	87.7	96.7	28.1	23.9	40.6	89.5	95.6	34.9	25.8	20.2
Bitternut hickory	1.2	.9	.1	0	0	1.2	1.2	N	N	0
Mockernut hickory	4.0	4.6	3.4	1.8	0	2.5	1.2	0	0	0
Pignut hickory	22.5	17.5	5.5	3.2	.4	3.7	4.9	2.5	0	0
Shagbark hickory	2.8	2.4	2.1	1.7	i	1.8	1.2	2.5	.6	0
Northern red oak	33.4	31.8	18.7	6.3	1.1	21.5	23.3	20.8	8.0	.6
Black oak	10.2	12.5	7.3	1.0	.5	3.7	3.7	1.8	0	0
Scarlet oak	5.3	5.3	4.7	1.6	1.0	.6	4.3	2.5	0	0
White oak	54.5	57.5	18.4	2.9	1.3	21.5	12.3	8.6	.6	0
Chestnut oak	9.5	11.1	12.5	2.6	1.9	1.8	12.3	5.5	1.8	2.5
Yellow birch	25.3	29.4	17.4	12.3	15.9	41.7	51.5	27.0	33.7	24.5
Black birch	33.1	41.4	11.9	14.9	21.2	10.4	13.5	4.9	5.5	8.0
Paper birch	.2	.1	.2	.3	.2	N	N	N	N	N
Beech	3.2	6.1	1.2	1.2	3.2	1.2	.6	0	1.8	3.7
White ash	26.6	28.0	8.6	5.5	2.6	23.9	25.8	11.6	5.5	6.1
Black ash	.4	.4	0	.2	0	.6	1.8	0	0	0
Basswood	1.3	1.3	.5	.1	0	.6	2.5	1.2	N	N
Tulip	2.7	4.3	.6	.1	1.6	1.2	5.5	1.2	0	3.1
American elm	2.3	1.9	1.1	1.1	0	8.6	8.0	5.5	3.1	0
Bigtooth aspen	5.6	8.2	.3	.1	N	12.9	22.1	N	N	N
Quaking aspen	0	.1	N	N	N	0	.6	N	N	N
Tupelo	2.9	2.3	.8	.5	1.2	6.1	4.3	1.8	.6	6.1
Black locust	.2	0	0	0	0	N	N	N	N	N
Butternut	3.5	1.0	N	N	.1	3.1	.6	N	N	N
Black cherry	9.4	1.6	.1	N	0	27.6	4.9	.6	N	N
Sassafras	7.4	4.3	2.8	5.0	10.5	6.7	3.7	4.9	6.1	6.1
White pine	0	.2	.7	N	.1	N	.6	N	N	N
Hemlock	0	0	0	0	.1	0	0	0	0	0
MAJOR SPECIES	361.8	382.4	152.2	90.6	107.2	302.3	332.9	149.0	103.6	87.1
Chestnut	10.9	1.2	19.9	31.9	44.1	3.1	.6	4.9	7.4	12.9
Flowering dogwood	11.7	17.0	5.3	6.4	36.1	5.5	1.8	1.8	3.7	21.5
Blue-beech	96.4	72.5	37.7	12.2	3.5	136.1	106.7	65.0	29.4	6.7
Shadbush	6.0	12.1	1.6	.7	.8	9.2	19.6	2.5	.6	2.5
Hophornbeam	17.7	9.9	13.8	1.0	.5	16.6	8.0	27.6	1.2	.6
Gray birch	43.8	27.3	.7	.1	.1	58.9	34.3	1.2	N	N
Redcedar	3.2	.1	.1	N	N	N	N	N	N	N
MINOR SPECIES	189.7	140.0	79.0	52.3	85.1	229.3	171.1	103.0	42.3	44.1
ALL SPECIES	551.4	522.3	231.2	142.9	192.3	531.6	504.0	252.0	145.9	131.2

Table 7b. Periodic mortality (stems/A) during 1927-87. Average over all tracts. All sites includes wet.  
 N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	7.0	9.8	4.4	3.6	3.4	2.2	2.9	2.2	.7	2.2
Red maple	86.6	95.8	26.1	22.7	44.6	103.6	104.3	31.9	25.4	46.4
Bitternut hickory	1.5	1.0	.1	0	0	N	N	N	N	N
Mockernut hickory	4.4	4.6	4.1	1.9	0	4.3	9.4	4.3	3.6	0
Pignut hickory	24.4	14.8	5.2	3.1	.4	39.1	48.6	11.6	8.0	.7
Shagbark hickory	3.4	2.4	2.1	2.4	.1	1.4	4.3	2.2	N	N
Northern red oak	38.2	34.8	19.8	6.7	1.2	29.7	32.6	13.8	3.6	.7
Black oak	9.2	9.6	6.8	.4	.7	24.6	39.1	17.4	5.1	0
Scarlet oak	6.4	4.0	4.6	2.2	1.0	6.5	13.8	8.7	.7	2.2
White oak	64.6	61.5	18.1	3.4	1.3	53.6	101.4	34.8	3.6	2.9
Chestnut oak	11.7	11.8	16.4	3.0	2.1	9.4	8.0	3.6	2.2	.7
Yellow birch	26.8	30.4	19.0	9.9	17.0	2.9	3.6	.7	.7	2.9
Black birch	37.8	46.8	13.9	16.7	20.9	42.8	55.1	12.3	18.8	42.0
Paper birch	.3	.1	.3	.4	.3	N	N	N	N	N
Beech	3.7	6.7	1.3	1.3	3.6	3.6	10.9	2.2	0	1.4
White ash	32.4	31.4	8.7	5.9	2.2	5.8	18.1	4.3	.7	N
Black ash	.4	.1	N	N	0	N	N	N	.7	N
Basswood	1.8	1.3	.4	.1	0	N	N	N	N	N
Tulip	3.6	5.0	.6	.1	1.6	.7	0	0	0	0
American elm	.7	.7	.1	.3	0	.7	N	N	N	N
Bigtooth aspen	2.5	5.3	.4	.1	N	13.0	7.2	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	2.1	2.4	.6	.6	.3	2.2	0	.7	0	0
Black locust	N	N	N	N	N	1.4	0	0	0	0
Butternut	3.3	.9	N	N	.1	5.8	2.2	N	N	N
Black cherry	5.2	.9	N	N	0	10.1	1.4	N	N	N
Sassafras	6.7	4.9	2.7	5.3	11.8	13.0	2.9	1.4	2.9	10.9
White pine	0	.1	1.0	N	.1	N	N	N	N	N
Hemlock	0	0	0	0	.1	N	N	N	N	N
MAJOR SPECIES	392.8	387.5	157.2	90.3	113.1	382.6	465.9	152.2	76.8	113.0
Chestnut	10.5	1.0	23.1	37.5	45.2	23.9	2.9	25.4	39.1	83.3
Flowering dogwood	14.4	22.7	7.3	8.0	46.5	8.0	10.1	.7	2.9	8.7
Blue-beech	105.0	76.6	37.0	10.4	3.6	23.2	23.9	13.8	1.4	0
Shadbush	4.3	10.8	1.6	.4	.3	11.6	11.6	.7	1.4	1.4
Hophornbeam	21.2	11.3	11.1	1.2	.3	5.1	7.2	13.0	0	1.4
Gray birch	42.5	26.2	.7	.1	N	39.9	29.0	N	N	.7
Redcedar	4.1	.1	.1	N	N	2.9	N	N	N	N
MINOR SPECIES	201.9	148.6	81.0	57.6	95.8	114.5	84.8	53.6	44.9	95.7
ALL SPECIES	586.6	535.9	238.0	147.9	208.9	491.3	550.7	205.8	121.7	208.7

Table 8a. Periodic basal area mortality ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	0.1	0.3	T	T	T	0.5	1.0	0.2	0.1	0.2
Red maple	1.2	4.0	1.2	1.7	1.8	2.4	9.0	2.9	4.3	1.5
Bitternut hickory	T	T	T	0.0	0.0	T	T	N	N	0.0
Mockernut hickory	0.1	T	0.4	0.5	0.0	T	T	0.0	0.0	0.0
Pignut hickory	0.3	0.4	0.4	1.2	T	T	T	0.4	0.0	0.0
Shagbark hickory	T	0.1	0.3	0.3	T	T	T	0.4	0.2	0.0
Northern red oak	0.7	2.4	3.6	2.6	0.7	0.4	1.5	4.4	3.5	0.4
Black oak	0.3	0.7	1.9	0.5	0.5	0.1	0.4	0.5	0.0	0.0
Scarlet oak	0.3	0.7	1.9	1.1	1.0	T	1.0	1.9	0.0	0.0
White oak	0.8	2.6	4.1	0.5	0.3	0.2	0.4	1.2	T	0.0
Chestnut oak	0.3	1.4	5.1	1.0	0.3	T	0.7	3.8	1.9	0.7
Yellow birch	0.6	1.6	1.3	0.9	0.6	1.6	2.4	2.9	3.7	1.0
Black birch	1.7	2.5	1.2	1.5	2.0	3.5	0.5	0.6	0.9	1.0
Paper birch	T	T	T	T	T	N	N	N	N	N
Beech	T	T	T	T	T	T	T	0.0	T	T
White ash	0.4	1.4	0.4	0.7	0.5	0.4	1.4	0.6	0.9	1.6
Black ash	T	T	0.0	T	0.0	T	0.4	0.0	0.0	0.0
Basswood	T	0.2	T	T	0.0	T	0.6	0.2	N	N
Tulip	T	1.0	T	T	0.4	T	1.2	0.1	0.0	1.4
American elm	T	0.1	0.2	0.2	0.0	0.2	0.4	1.1	0.8	0.0
Bigtooth aspen	0.5	1.8	T	T	N	1.5	4.6	N	N	N
Quaking aspen	0.0	T	N	N	N	0.0	T	N	N	N
Tupelo	T	T	T	T	T	T	0.1	T	T	T
Black locust	T	0.0	0.0	0.0	0.0	N	N	N	N	N
Butternut	0.2	0.1	N	N	T	0.3	T	N	N	N
Black cherry	0.2	T	T	N	0.0	0.7	0.2	T	N	N
Sassafras	0.1	0.2	0.2	0.1	T	0.3	0.2	0.1	T	T
White pine	0.0	T	T	N	T	N	T	N	N	N
Hemlock	0.0	0.0	0.0	0.0	T	0.0	0.0	0.0	0.0	0.0
MAJOR SPECIES	8.1	22.0	22.5	13.2	8.4	12.5	26.2	21.5	16.5	8.0
Chestnut	T	T	0.1	0.2	0.4	T	T	T	T	0.1
Flowering dogwood	0.1	0.3	0.1	0.1	0.7	T	T	T	T	0.3
Blue-beech	0.8	0.9	0.6	0.2	T	1.2	1.4	1.6	0.5	T
Shadbush	T	0.2	T	T	T	T	0.4	T	T	T
Hophornbeam	0.2	0.2	0.4	T	T	0.3	0.4	0.8	T	T
Gray birch	1.3	2.1	T	T	T	2.1	2.8	0.2	N	N
Redcedar	0.2	T	T	N	N	N	N	N	N	N
MINOR SPECIES	2.8	3.7	1.3	0.6	1.1	3.8	4.9	2.7	0.7	0.5
ALL SPECIES	10.9	25.8	23.8	13.7	9.5	16.3	31.2	24.1	17.2	8.4



Table 8b. Periodic basal area mortality (ft<sup>2</sup>/A) during 1927-87. Average over all tracts. All sites includes wet. T represents less than 0.1 ft<sup>2</sup>/A. N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	T	0.1	T	0.1	T	T	T	T	T	T
Red maple	1.0	2.6	0.9	1.2	2.0	1.2	2.2	0.8	0.8	0.9
Bitternut hickory	T	T	T	0.0	0.0	N	N	N	N	N
Mockernut hickory	0.2	T	0.5	0.6	0.0	T	0.2	0.2	0.7	0.0
Pignut hickory	0.3	0.3	0.4	1.5	T	0.6	1.5	0.6	1.7	0.3
Shagbark hickory	T	0.2	0.3	0.5	T	T	T	0.2	N	N
Northern red oak	0.9	2.8	4.0	2.7	0.9	0.3	2.0	1.1	1.5	0.1
Black oak	0.3	0.7	1.8	0.2	0.7	0.5	1.1	3.8	2.5	0.0
Scarlet oak	0.4	0.7	1.9	1.6	1.1	0.2	0.7	2.1	0.2	1.6
White oak	1.0	3.1	4.4	0.6	0.3	0.6	3.3	7.1	0.6	0.7
Chestnut oak	0.3	1.8	6.5	0.8	0.3	0.4	0.2	1.0	1.0	T
Yellow birch	0.6	1.8	1.2	0.5	0.6	T	T	T	T	T
Black birch	1.4	3.3	1.5	1.7	1.8	1.3	1.7	0.7	1.3	4.6
Paper birch	T	T	T	0.1	0.1	N	N	N	N	N
Beech	T	T	T	T	T	T	0.1	T	0.0	T
White ash	0.5	1.5	0.4	0.7	0.3	0.1	1.1	0.3	0.1	N
Black ash	T	T	N	N	0.0	N	N	N	T	N
Basswood	T	T	T	T	0.0	N	N	N	N	N
Tulip	0.1	1.2	T	T	0.2	T	0.0	0.0	0.0	0.0
American elm	T	T	T	T	0.0	T	N	N	N	N
Bigtooth aspen	0.3	1.3	T	T	N	0.6	1.1	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	T	T	T	T	T	T	0.0	T	0.0	0.0
Black locust	N	N	N	N	N	T	0.0	0.0	0.0	0.0
Butternut	0.2	0.1	N	N	T	0.1	0.1	N	N	N
Black cherry	0.1	T	N	N	0.0	0.2	T	N	N	N
Sassafras	T	0.2	0.3	0.1	T	0.2	T	T	T	T
White pine	0.0	0.1	T	N	T	N	N	N	N	N
Hemlock	0.0	0.0	0.0	0.0	T	N	N	N	N	N
MAJOR SPECIES	7.6	22.4	24.3	13.1	8.7	6.4	15.6	18.0	10.3	8.4
Chestnut	T	T	0.1	0.2	0.4	0.1	T	0.1	0.2	0.6
Flowering dogwood	0.2	0.4	0.2	0.2	0.9	T	0.1	T	T	0.2
Blue-beech	0.8	0.9	0.5	0.1	T	0.4	0.3	T	T	0.0
Shadbush	T	0.1	T	T	T	T	0.2	T	0.1	T
Hophornbeam	0.2	0.2	0.3	T	T	T	0.2	0.2	0.0	T
Gray birch	1.3	2.1	T	T	N	1.0	1.6	N	N	T
Redcedar	0.2	T	T	N	N	0.2	N	N	N	N
MINOR SPECIES	2.8	3.8	1.2	0.6	1.3	2.0	2.4	0.5	0.4	0.9
ALL SPECIES	10.4	26.2	25.5	13.7	10.0	8.4	18.0	18.4	10.7	9.2

Table 9a. Periodic ingrowth during 1927-87 (stems/A). Average over all tracts. All sites includes wet. N indicates no ingrowth.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	3.4	11.6	2.9	5.7	4.7	8.0	25.2	4.9	6.1	6.1
Red maple	12.9	42.8	26.1	66.1	28.9	11.6	24.0	9.8	23.3	14.7
Bitternut hickory	N	N	N	.2	N	N	N	N	1.2	N
Mockernut hickory	.2	.4	.2	.2	.1	N	N	N	N	N
Pignut hickory	1.8	1.6	.3	.9	1.4	.6	.6	N	3.7	3.1
Shagbark hickory	N	.2	.2	.1	.1	N	N	.6	.6	N
Northern red oak	4.9	3.6	.7	1.1	1.8	8.0	3.6	.6	1.8	1.2
Black oak	1.7	.8	.1	1.0	2.1	N	N	N	N	N
Scarlet oak	.1	.6	N	.3	.3	N	N	N	N	N
White oak	4.8	3.0	.2	1.5	2.5	N	3.0	N	.6	.6
Chestnut oak	3.1	5.2	.5	4.1	2.8	4.3	.6	N	2.5	N
Yellow birch	7.3	19.8	12.6	54.6	36.8	19.0	23.2	15.3	101.2	60.1
Black birch	6.6	18.0	18.6	49.0	33.8	1.2	9.8	8.6	33.7	15.3
Paper birch	.1	.2	N	N	N	N	N	N	N	N
Beech	2.3	9.6	7.0	18.4	14.3	1.2	15.4	3.7	12.9	17.8
White ash	2.2	5.0	.9	1.2	.8	2.5	9.2	1.8	1.2	1.8
Black ash	N	.2	.3	.3	.3	N	1.2	N	1.2	1.8
Basswood	.1	N	N	N	N	.6	N	N	N	N
Tulip	.1	.6	.2	5.2	5.7	.6	.6	.6	17.8	11.6
American elm	.3	.42	.1	.1	N	1.2	.6	N	N	N
Bigtooth aspen	.1	.2	N	N	N	N	N	N	N	N
Tupelo	.6	.6	1.1	4.3	1.7	1.2	1.2	3.1	18.4	6.1
Butternut	.2	N	N	.1	N	N	N	N	N	N
Black cherry	.1	N	N	.1	.5	N	N	N	N	N
Sassafras	.3	4.0	6.9	16.3	3.9	N	8.0	4.3	9.2	1.2
White pine	.1	.6	N	.3	.1	.6	N	N	N	N
Hemlock	N	N	N	.1	N	N	N	N	N	N
MAJOR SPECIES	53.3	129.6	78.9	231.2	142.6	60.7	126.4	53.3	235.4	141.6
Chestnut	.7	35.8	23.1	40.7	10.0	.6	12.2	1.8	13.5	1.8
Flowering dogwood	5.8	11.4	7.6	17.4	1.3	N	6.2	8.0	9.2	N
Blue-beech	6.5	22.8	3.3	5.3	10.3	12.9	39.2	8.0	13.5	15.3
Shadbush	1.6	1.0	.4	.6	.3	3.7	1.8	N	2.5	N
Hophornbeam	2.0	5.2	.6	1.8	11.1	4.9	16.6	.6	1.2	4.9
Gray birch	.5	.2	N	.1	N	N	N	N	N	N
MINOR SPECIES	17.1	76.6	35.0	65.9	33.0	22.1	76.0	18.4	39.9	22.1
ALL SPECIES	70.4	206.2	113.9	297.1	175.6	82.8	202.4	71.7	275.3	163.7

Table 9b. Periodic ingrowth during 1927-87 (stems/A). Average over all tracts. All sites includes wet. N indicates no ingrowth.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	3.1	10.2	3.0	5.9	5.2	N	4.4	N	5.1	1.4
Red maple	13.6	40.4	26.4	72.6	30.8	10.9	62.4	47.1	93.5	39.1
Bitternut hickory	N	N	N	N	N	N	N	N	N	N
Mockernut hickory	.3	.8	.3	.3	N	N	N	N	N	.7
Pignut hickory	1.3	2.2	.3	.4	.6	5.8	.7	.7	N	3.6
Shagbark hickory	N	N	.1	N	.1	N	.7	N	N	N
Northern red oak	4.3	3.2	.9	.7	1.5	5.1	5.1	N	2.2	4.3
Black oak	1.3	.8	N	1.0	1.5	5.8	2.2	.7	2.2	8.0
Scarlet oak	.1	.8	N	.4	N	N	1.4	N	N	2.2
White oak	5.5	3.2	.1	1.6	1.9	8.0	2.2	.7	2.2	8.0
Chestnut oak	2.8	7.0	.3	4.6	3.1	3.6	2.8	2.2	4.3	5.1
Yellow birch	6.1	22.8	14.4	54.8	39.1	.7	2.8	2.9	8.0	4.3
Black birch	7.0	17.6	19.8	47.5	32.6	12.3	31.8	26.8	82.6	67.4
Paper birch	.1	.2	N	N	N	N	N	N	N	N
Beech	2.1	8.6	8.3	19.4	13.5	5.1	10.2	5.8	23.2	16.7
White ash	1.9	4.0	.7	1.5	.7	2.9	1.4	N	N	N
Black ash	N	N	N	.1	N	N	N	.7	N	N
Basswood	N	N	N	N	N	N	N	N	N	N
Tulip	N	.8	.1	3.3	5.5	N	N	N	.7	.7
American elm	.1	N	N	.1	N	N	N	N	N	N
Bigtooth aspen	.1	.2	N	N	N	N	N	N	N	N
Tupelo	.6	.8	.9	1.9	1.0	N	N	N	N	N
Butternut	.1	N	N	.1	N	.7	N	N	N	N
Black cherry	N	N	N	.1	.7	.7	N	N	N	N
Sassafras	.3	3.6	7.0	19.1	5.0	.7	2.2	10.9	13.8	2.2
White pine	N	1.0	N	.4	N	N	N	N	N	.7
Hemlock	N	N	N	.1	N	N	N	N	N	N
MAJOR SPECIES	50.9	128.0	82.6	236.3	142.9	62.3	130.4	98.6	237.7	164.5
Chestnut	.4	41.4	27.5	41.0	11.3	2.2	43.4	30.4	78.3	15.2
Flowering dogwood	8.3	15.0	9.2	22.8	1.9	1.4	2.8	.7	3.6	N
Blue-beech	5.9	22.0	2.8	4.1	11.0	2.9	8.6	.7	2.2	2.9
Shadbush	1.2	1.0	.4	.3	.4	1.4	.7	.7	N	N
Hophornbeam	1.0	2.6	.6	2.1	15.0	3.6	5.8	.7	1.4	1.4
Gray birch	.4	.2	N	N	N	1.4	N	N	.7	N
MINOR SPECIES	17.3	82.0	40.6	70.3	39.5	13.0	61.4	33.3	86.2	19.6
ALL SPECIES	68.3	210.2	123.2	306.7	182.4	75.4	192.0	131.9	323.9	184.1

Table 10a. Persistence (stems/A) during 1927-87 of stems present at the beginning of each interval. Average over all tracts. All sites includes wet. T represents less than 0.1 stem/A. N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	31.0	23.0	29.5	28.1	30.2	68.7	49.7	63.8	58.2	58.2
Red maple	183.5	99.7	114.4	116.6	142.1	193.7	109.7	98.7	82.8	85.8
Bitternut hickory	1.1	.2	T	T	.3	1.2	0	0	0	1.2
Mockernut hickory	9.5	5.1	2.2	.6	.8	1.8	.6	.6	.6	.6
Pignut hickory	24.6	8.9	5.1	2.2	2.7	7.4	3.1	1.2	1.2	4.9
Shagbark hickory	7.2	4.8	2.8	1.3	1.3	6.7	5.5	3.1	3.1	3.7
Northern red oak	66.4	39.5	24.4	18.8	18.8	52.1	36.8	19.6	12.3	13.5
Black oak	26.1	15.3	8.8	7.9	8.4	6.7	3.1	1.2	1.2	1.2
Scarlet oak	17.1	11.9	7.9	6.3	5.6	9.2	4.9	2.5	2.5	2.5
White oak	76.1	23.4	8.0	5.3	5.5	20.2	8.0	2.5	1.8	2.5
Chestnut oak	21.7	13.7	6.4	4.3	6.5	15.3	7.4	2.5	.6	.6
Yellow birch	63.1	41.0	43.5	43.8	82.5	123.9	91.4	87.7	69.3	145.9
Black birch	90.1	55.3	61.4	65.1	92.9	34.9	22.7	27.6	30.7	56.4
Paper birch	.5	.5	.5	.2	0	N	N	N	N	N
Beech	10.9	7.1	15.6	21.4	36.6	.6	1.2	16.6	18.4	27.6
White ash	40.1	14.3	10.8	6.2	4.8	42.9	19.6	17.2	13.5	8.6
Black ash	.5	T	.3	.4	.7	1.8	0	1.2	1.2	2.5
Basswood	1.9	.7	.2	T	T	3.1	1.2	0	0	0
Tulip	9.1	4.9	4.9	5.0	8.6	9.8	4.9	4.3	4.9	19.6
American elm	3.5	1.9	1.2	.2	.3	15.3	8.6	3.7	.6	.6
Bigtooth aspen	8.4	.3	T	0	0	22.1	0	0	0	0
Quaking aspen	T	0	0	0	0	.6	0	0	0	0
Tupelo	3.4	3.3	3.9	7.0	.1	13.5	10.4	9.8	12.3	24.5
Black locust	T	T	T	T	T	N	N	N	N	N
Butternut	.8	0	0	0	0	.6	0	0	0	0
Black cherry	1.6	T	0	0	T	5.5	.6	0	0	0
Sassafras	6.3	2.3	3.5	5.4	11.2	4.9	1.2	4.3	2.5	5.5
White pine	T	0	0	0	.2	0	0	0	0	0
Hemlock	.3	.3	.3	.3	.3	.6	.6	.6	.6	.6
MAJOR SPECIES	706.7	377.9	355.3	343.6	467.6	663.4	391.2	368.5	318.2	466.6
Chestnut	.9	.4	16.4	7.6	4.2	0	0	7.4	1.8	2.5
Flowering dogwood	28.0	16.8	23.0	24.2	5.5	11.0	9.2	13.5	17.8	5.5
Bluebeech	95.6	29.6	14.8	5.9	7.7	151.4	57.6	31.9	10.4	17.2
Shadbush	11.9	1.4	.9	.6	.4	17.8	1.8	1.2	.6	.6
Hophornbeam	17.9	10.0	1.4	1.0	2.3	15.9	12.9	1.8	1.2	1.8
Gray birch	27.5	.7	T	0	0	35.6	1.2	0	0	0
Redcedar	.2	T	0	0	0	N	N	N	N	N
MINOR SPECIES	182.0	58.9	56.6	39.3	20.1	231.8	82.8	55.8	31.9	27.6
ALL SPECIES	888.7	436.8	411.9	382.9	487.7	895.2	473.9	424.3	350.1	494.2



Table 10b. Persistence (stems/A) during 1927-87 of stems present at the beginning of each interval. Average over all tracts. All sites includes wet. T represents less than 0.1 stem/A. N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	27.4	20.7	26.5	25.9	28.4	9.4	6.5	8.7	8.0	10.9
Red maple	181.3	99.1	113.4	117.1	145.1	190.6	97.1	127.5	149.3	196.4
Bitternut hickory	1.3	.3	.1	.1	.1	N	N	N	N	N
Mockernut hickory	9.9	5.6	2.2	.6	.9	18.1	8.7	4.3	.7	.7
Pignut hickory	21.9	8.4	5.5	2.7	2.7	62.3	19.6	8.7	1.4	.7
Shagbark hickory	7.8	5.5	3.4	1.2	1.0	5.8	1.4	0	0	0
Northern red oak	72.3	41.8	25.2	19.4	19.0	65.9	38.4	29.7	26.1	27.5
Black oak	22.5	14.2	8.1	7.7	8.0	71.0	37.7	22.5	18.1	20.3
Scarlet oak	15.5	11.7	7.8	5.6	5.0	37.0	23.2	15.9	15.2	13.0
White oak	79.2	23.2	8.4	5.2	5.5	139.9	46.4	13.8	10.9	10.1
Chestnut oak	25.6	16.6	7.1	4.4	7.0	13.8	9.4	8.7	8.7	12.3
Yellow birch	62.2	37.9	41.8	46.2	84.0	5.8	2.9	5.1	7.2	12.3
Black birch	100.1	60.3	64.0	67.1	93.7	121.7	79.0	98.6	106.5	147.1
Paper birch	.7	.7	.7	.3	0	N	N	N	N	N
Beech	11.6	7.0	14.2	21.2	37.0	21.7	15.9	23.9	29.7	51.4
White ash	44.4	15.0	10.2	5.0	4.3	18.8	3.6	.7	0	0
Black ash	.1	0	0	0	.1	0	0	0	0	0
Basswood	2.1	.7	.3	.1	.1	N	N	N	N	N
Tulip	11.0	5.9	6.1	6.1	7.7	.7	.7	.7	.7	1.4
American elm	1.0	.4	.3	0	.1	0	0	0	0	0
Bigtooth aspen	5.6	.4	.1	0	0	7.2	0	0	0	0
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	4.0	2.2	2.4	2.7	4.3	1.4	1.4	.7	.7	.7
Black locust	.7	.7	.7	.7	.7	N	N	N	N	N
Butternut	.7	0	0	0	0	1.4	0	0	0	0
Black cherry	.9	0	0	0	.1	.7	0	0	0	0
Sassafras	7.0	2.4	3.3	4.9	12.1	5.8	3.6	4.3	12.3	15.2
White pine	.1	0	0	0	.3	N	N	N	N	N
Hemlock	.3	.3	.3	.3	.3	N	N	N	N	N
MAJOR SPECIES	716.7	380.5	351.5	343.8	467.1	800.0	396.4	374.6	396.4	521.0
Chestnut	1.0	.4	18.7	8.7	4.6	1.4	.7	18.8	10.1	5.1
Flowering dogwood	35.8	21.5	29.2	30.4	6.7	14.5	5.8	8.0	5.8	.7
Bluebeech	99.2	28.6	13.6	6.1	6.7	26.8	5.8	.7	0	2.2
Shadbush	10.7	1.0	.4	.4	.4	12.3	2.2	2.2	1.4	0
Hophornbeam	20.4	10.2	1.6	1.0	2.8	10.9	7.2	0	.7	.7
Gray birch	26.5	.7	.1	0	0	27.5	0	0	0	0
Redcedar	.3	.1	0	0	0	0	0	0	0	0
MINOR SPECIES	194.0	62.6	63.7	46.6	21.2	93.5	21.7	29.7	18.1	8.7
ALL SPECIES	910.7	443.1	415.2	390.5	488.2	893.5	418.1	404.3	414.5	529.7

Table 11a. Basal area ( $\text{ft}^2/\text{A}$ ) at the beginning of an interval of stems persisting throughout the interval. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	1.1	1.2	1.8	2.1	2.8	3.5	3.6	5.3	6.1	7.6
Red maple	9.0	7.9	10.4	11.4	13.1	19.3	15.5	19.4	19.0	21.8
Bitternut hickory	T	T	T	T	T	T	0	0	0	T
Mockernut hickory	.5	.6	.4	T	T	T	T	T	T	T
Pignut hickory	1.2	1.3	1.3	.5	.5	.3	.3	T	T	T
Shagbark hickory	.6	.6	.6	.4	.4	.7	.8	1.1	1.2	1.4
Northern red oak	7.7	10.9	16.9	17.7	20.1	5.8	9.2	14.8	14.5	16.9
Black oak	3.0	4.8	6.9	7.8	8.6	1.4	1.6	2.2	2.6	3.0
Scarlet oak	3.0	4.2	5.3	5.2	5.0	1.5	1.9	1.6	1.9	2.2
White oak	5.5	5.4	3.6	3.6	3.8	1.4	1.7	1.2	1.4	1.6
Chestnut oak	4.3	5.1	2.7	2.2	2.3	2.9	3.9	2.3	.8	T
Yellow birch	4.7	5.0	5.5	5.6	6.8	11.9	13.5	15.4	14.2	16.7
Black birch	7.2	8.1	11.0	11.9	13.4	5.8	7.5	10.4	11.4	12.5
Paper birch	T	.1	.1	T	0	N	N	N	N	N
Beech	.2	.3	.6	.9	1.7	.1	.3	.8	1.1	1.7
White ash	2.4	1.9	2.3	2.0	2.0	3.7	3.8	4.8	4.6	3.7
Black ash	T	T	T	T	T	.4	0	T	T	T
Basswood	.2	.1	.1	.1	.1	.5	.2	0	0	0
Tulip	1.8	1.8	3.5	4.5	5.7	2.2	2.4	4.6	5.9	6.5
American elm	.3	.3	.2	T	T	1.6	1.5	.8	T	T
Bigtooth aspen	1.4	T	T	0	0	3.5	0	0	0	0
Quaking aspen	T	0	0	0	0	T	0	0	0	0
Tupelo	.2	.1	.2	.2	.3	.2	.3	.3	.5	.8
Black locust	T	T	T	T	T	T	0	0	0	0
Butternut	T	0	0	0	0	N	N	N	N	N
Black cherry	T	T	0	0	T	.1	T	0	0	0
Sassafras	.2	.2	.1	T	.2	.1	T	T	T	T
White pine	T	0	0	0	T	0	0	0	0	0
Hemlock	T	T	T	T	T	T	T	T	.1	.2
MAJOR SPECIES	54.7	60.1	73.8	76.3	86.9	67.1	68.1	85.1	85.5	96.7
Chestnut	T	T	T	T	T	0	0	T	T	T
Flowering dogwood	.5	.4	.6	.6	.2	.2	.2	.3	.4	.3
Blue-beech	1.0	.5	.2	T	T	1.8	1.2	.5	.1	.2
Shadbush	.1	T	T	T	T	.2	T	T	T	T
Hophornbeam	.4	.3	T	T	T	.8	.6	T	T	T
Gray birch	1.6	T	T	0	0	2.1	T	0	0	0
Redcedar	T	T	0	0	0	N	N	N	N	N
MINOR SPECIES	3.6	1.3	.9	.7	.3	5.0	2.1	.9	.5	.5
ALL SPECIES	58.4	61.3	74.7	77.0	87.2	72.2	70.2	86.0	86.0	97.2

Table 11b. Basal area ( $\text{ft}^2/\text{A}$ ) at the beginning of an interval of stems persisting throughout the interval. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.8	.9	1.4	1.6	2.1	T	.1	.2	.2	.5
Red maple	6.8	6.6	8.8	9.9	11.3	4.7	4.5	6.0	7.4	9.1
Bitternut hickory	T	T	T	T	T	N	N	N	N	N
Mockernut hickory	.5	.7	.5	T	.1	.6	.7	.7	T	T
Pignut hickory	1.3	1.4	1.5	.5	.6	2.1	2.0	2.2	.8	.6
Shagbark hickory	.7	.7	.6	.3	.3	.1	.1	0	0	0
Northern red oak	9.1	12.5	18.7	19.6	22.0	4.5	7.0	13.4	14.9	17.7
Black oak	2.9	4.7	6.8	7.9	8.6	5.7	9.8	14.2	14.4	16.6
Scarlet oak	3.3	4.5	5.6	5.0	4.7	3.9	6.5	9.5	10.8	10.7
White oak	6.2	5.7	3.9	3.9	4.1	7.7	9.2	5.3	5.3	5.5
Chestnut oak	5.4	6.2	3.0	2.7	2.7	1.7	2.0	2.3	2.2	3.2
Yellow birch	4.0	4.1	4.3	4.7	5.8	.5	.5	.6	.6	.8
Black birch	8.0	8.5	11.4	12.2	14.0	5.8	8.1	11.4	12.9	13.4
Paper birch	T	.2	.2	.1	0	N	N	N	N	N
Beech	.2	.2	.5	.8	1.6	.4	.5	.8	1.3	2.4
White ash	2.4	1.9	2.2	1.8	1.8	1.0	.3	T	0	0
Black ash	T	0	0	0	T	0	0	0	0	0
Basswood	.2	.2	.2	.2	.2	N	N	N	N	N
Tulip	2.1	2.1	4.0	5.0	6.7	T	.2	.4	.6	1.0
American elm	T	T	T	0	T	0	0	0	0	0
Bigtooth aspen	1.0	T	T	0	0	.9	0	0	0	0
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	.1	.1	.1	.2	.2	T	T	T	T	T
Black locust	N	N	N	N	N	T	T	.2	.3	.4
Butternut	.1	0	0	0	0	T	0	0	0	0
Black cherry	T	0	0	0	T	T	0	0	0	0
Sassafras	.3	.2	.1	T	.2	T	T	T	.2	.3
White pine	.1	0	0	0	T	N	N	N	N	N
Hemlock	T	T	T	T	T	N	N	N	N	N
MAJOR SPECIES	55.7	61.4	74.0	76.5	87.2	40.0	51.7	67.2	72.0	82.0
Chestnut	T	T	T	T	T	T	T	T	T	T
Flowering dogwood	.7	.5	.7	.7	.2	.2	.1	.2	.2	T
Blue-beech	1.0	.4	.2	T	T	.3	T	T	0	T
Shadbush	.1	T	T	T	T	.2	T	.1	T	0
Hophornbeam	.4	.3	T	T	T	.2	.1	0	T	T
Gray birch	1.6	T	T	0	0	1.3	0	0	0	0
Redcedar	T	T	0	0	0	0	0	0	0	0
MINOR SPECIES	3.7	1.3	1.0	.9	.3	2.2	.4	.4	.3	T
ALL SPECIES	59.4	62.7	75.0	77.3	87.5	42.1	52.1	67.6	72.2	82.0

Table 12a. Periodic accretion ( $\text{ft}^2/\text{A}$ ) during 1927-87 on stems persisting through each interval. Average over all tracts. All sites includes wet. T represents less than  $0.01 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.35	.63	.35	.66	.69	.96	1.92	.91	1.67	1.62
Red maple	2.79	3.38	2.49	3.10	3.13	5.00	7.22	3.75	3.96	4.50
Bitternut hickory	.01	.01	T	T	T	.01	N	N	N	T
Mockernut hickory	.21	.25	.06	T	T	0	.05	.01	.01	.01
Pignut hickory	.50	.49	.34	.05	.06	.08	.16	T	T	T
Shagbark hickory	.17	.34	.08	.05	.08	.20	.76	.22	.20	.23
Northern red oak	5.54	9.38	3.41	3.10	3.97	4.92	9.92	3.26	2.82	3.55
Black oak	2.44	3.83	1.39	1.26	1.35	.60	1.06	.40	.39	.23
Scarlet oak	1.96	3.02	.94	.73	.87	1.30	1.63	.37	.26	.43
White oak	2.47	2.27	.53	.43	.57	.77	.62	.24	.19	.38
Chestnut oak	2.09	2.73	.46	.29	.39	1.72	2.23	.39	N	T
Yellow birch	1.82	1.69	.87	1.34	2.39	3.85	4.73	2.09	2.63	3.62
Black birch	3.41	4.16	2.14	2.99	3.13	2.19	3.54	1.88	1.93	2.39
Paper birch	.04	.03	.02	T	N	N	N	N	N	N
Beech	.12	.25	.30	.70	1.18	.21	.24	.30	.49	.79
White ash	.92	.74	.38	.31	.32	1.44	1.53	.79	.68	.49
Black ash	T	.01	.01	T	.03	0	N	T	T	.02
Basswood	.09	.09	.01	T	T	.17	0	N	N	N
Tulip	1.07	1.76	.96	1.61	1.73	1.38	2.48	1.27	1.86	1.89
American elm	.07	.10	.04	T	.01	.29	.43	.05	T	.04
Bigtooth aspen	.48	.03	T	N	N	1.17	N	N	N	N
Quaking aspen	T	N	N	N	N	.03	N	N	N	N
Tupelo	.05	.02	.03	.07	.10	.15	.10	.17	.23	.40
Black locust	T	.02	.01	.02	.02	N	N	N	N	N
Butternut	.01	N	N	N	N	0	N	N	N	N
Black cherry	.02	0	N	N	T	.07	0	N	N	N
Sassafras	.15	.11	.04	.06	.12	.08	.04	.03	.02	.05
White pine	.01	N	N	N	T	N	N	N	N	N
Hemlock	T	.03	.03	.04	.04	.02	.05	.04	.08	.09
MAJOR SPECIES	26.81	35.40	14.92	16.83	20.18	26.62	38.72	16.18	17.44	20.74
Chestnut	0	0	.09	.13	.03	N	N	.05	.02	.01
Flowering dogwood	.16	.23	.11	.20	.04	.07	.07	.08	.16	.07
Blue-beech	.33	.27	.04	.02	.04	.71	.77	.09	.03	.12
Shadbush	.07	.02	T	T	T	.16	.03	T	N	T
Hophornbeam	.11	.08	T	T	.01	.10	.06	.02	.02	.02
Gray birch	.53	.03	T	N	N	.76	.09	N	N	N
Redcedar	0	T	N	N	N	N	N	N	N	N
MINOR SPECIES	1.20	.64	.25	.35	.12	1.79	1.03	.24	.22	.22
ALL SPECIES	28.01	36.04	15.17	17.19	20.30	28.41	39.74	16.42	17.66	20.96

Table 12b. Periodic accretion (ft<sup>2</sup>/A) during 1927-87 on stems persisting through each interval. Average over all tracts. All sites includes wet. T represents less than 0.01 ft<sup>2</sup>/A. N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.27	.46	.29	.55	.59	.06	.05	.03	.09	.17
Red maple	2.35	2.91	2.13	2.93	2.71	1.99	1.15	2.08	2.28	2.75
Bitternut hickory	.01	.02	T	T	T	N	N	N	N	N
Mockernut hickory	.26	.29	.07	T	.01	.26	.30	.06	T	T
Pignut hickory	.45	.50	.45	.07	.08	1.36	.95	.31	.04	.03
Shagbark hickory	.19	.30	.07	.03	.06	.09	.04	N	N	N
Northern red oak	6.13	9.94	3.65	3.34	4.24	4.34	7.57	3.00	2.82	3.86
Black oak	2.42	3.80	1.43	1.30	1.38	5.17	7.88	2.63	2.25	2.78
Scarlet oak	1.92	3.07	.99	.72	.82	3.25	4.90	1.58	1.43	1.74
White oak	2.50	2.55	.60	.50	.61	4.74	3.25	.60	.48	.66
Chestnut oak	2.56	3.21	.49	.34	.43	.58	1.45	.50	.42	.71
Yellow birch	1.75	1.32	.76	1.31	2.60	.04	.15	.05	.11	.19
Black birch	3.73	4.53	2.15	3.11	3.23	3.83	3.81	2.74	4.12	4.04
Paper birch	.05	.05	.03	T	N	N	N	N	N	N
Beech	.08	.26	.28	.73	1.20	.25	.28	.41	.91	1.70
White ash	.93	.69	.28	.22	.23	.40	.07	.05	N	N
Black ash	T	N	N	N	T	N	N	N	N	N
Basswood	.10	.13	.02	T	T	N	N	N	N	N
Tulip	1.23	1.95	1.09	1.89	2.03	.09	.28	.12	.21	.35
American elm	.02	T	0	N	T	N	N	N	N	N
Bigtooth aspen	.39	.05	T	N	N	.20	N	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	.03	T	T	.05	.05	0	.01	0	0	T
Black locust	N	N	N	N	N	.05	.13	.09	.12	.13
Butternut	.01	N	N	N	N	.03	N	N	N	N
Black cherry	.02	N	N	N	T	0	N	N	N	N
Sassafras	.19	.15	.05	.06	.14	.04	.03	.03	.11	.16
White pine	.02	N	N	N	T	N	N	N	N	N
Hemlock	T	.04	.03	.05	.04	N	N	N	N	N
MAJOR SPECIES	27.61	36.23	14.87	17.22	20.46	26.75	32.32	14.27	15.39	19.28
Chestnut	0	0	.10	.15	.04	0	0	.09	.16	.02
Flowering dogwood	.21	.32	.13	.25	.04	.07	.06	.04	.07	T
Blue-beech	.30	.20	.03	.02	.03	.06	.06	N	N	T
Shadbush	.04	.01	T	T	0	.13	.05	.03	.01	N
Hophornbeam	.13	.10	T	T	.01	.03	.04	N	0	T
Gray birch	.54	.02	T	N	N	.27	N	N	N	N
Redcedar	0	.01	N	N	N	N	N	N	N	N
MINOR SPECIES	1.22	.65	.27	.42	.12	.57	.21	.16	.24	.03
ALL SPECIES	28.83	36.88	15.15	17.64	20.58	27.32	32.52	14.43	15.63	19.31



Table 13a. Components of basal area growth ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ .

SPECIES	COMPONENT	All Sites					Moist				
		1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	Accretion	.4	.6	.4	.7	.7	1.0	1.9	.9	1.7	1.6
	Ingrowth	T	.1	T	T	T	0	0	0	0	.1
	Mortality	.1	.3	T	T	T	.5	1.0	.2	.1	.2
	Net growth	.3	.4	.3	.6	.7	.5	1.0	.7	1.6	1.5
Red maple	Accretion	2.8	3.4	2.5	3.1	3.1	5.0	7.2	3.8	4.0	4.5
	Ingrowth	.1	.3	.2	.4	.5	0	0	.1	.3	1.1
	Mortality	1.2	4.0	1.2	1.7	1.8	2.4	9.0	2.9	4.3	1.5
	Net growth	1.7	-.3	1.5	1.8	1.8	2.6	-2.1	1.0	0	4.1
Northern red oak	Accretion	5.5	9.4	3.4	3.1	4.0	4.9	9.9	3.3	2.8	3.6
	Ingrowth	.1	.1	.1	T	T	.1	0	0	0	0
	Mortality	.7	2.4	3.6	2.6	.7	.4	1.5	4.4	3.5	.4
	Net growth	4.9	7.1	-.1	.5	3.3	4.6	8.4	-1.1	-.7	3.1
White oak	Accretion	2.5	2.3	.5	.4	.6	.8	.6	.2	.2	.4
	Ingrowth	.1	T	T	.1	T	0	0	.1	T	T
	Mortality	.8	2.6	4.1	.5	.3	.2	.4	1.2	T	0
	Net growth	1.8	-.3	-3.6	0	.3	.6	.2	-.9	.3	.4
Yellow birch	Accretion	1.8	1.7	.9	1.3	2.4	3.8	4.7	2.1	2.6	3.6
	Ingrowth	.1	T	.1	.5	.2	.3	0	.4	.9	.4
	Mortality	.6	1.6	1.3	.9	.6	1.6	2.4	2.9	3.7	1.0
	Net growth	1.3	.1	-.3	.9	2.0	2.5	2.3	-.4	-.2	3.0

Table 13b. Components of basal area growth ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ .

SPECIES	COMPONENT	Medium Moist					Dry				
		1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	Accretion	.3	.5	.3	.6	.6	.1	T	T	.1	.2
	Ingrowth	0	0	0	0	0	T	0	0	.2	0
	Mortality	T	.1	T	.1	T	T	T	T	T	T
	Net growth	.2	.4	.2	.5	.6	.1	0	0	.3	.2
Red maple	Accretion	2.4	2.9	2.1	2.9	2.7	2.0	1.2	2.1	2.3	2.8
	Ingrowth	.2	.1	.2	.5	.3	.2	1.0	.1	.4	0
	Mortality	1.0	2.6	.9	1.2	2.0	1.2	2.2	.8	.8	.9
	Net growth	1.6	.4	1.4	2.2	1.0	1.0	0	1.4	1.9	1.9
Northern red oak	Accretion	6.1	9.9	3.6	3.3	4.2	4.3	7.6	3.0	2.8	3.9
	Ingrowth	.2	.3	0	0	.1	0	0	0	.1	0
	Mortality	.9	2.8	4.0	2.7	.9	.3	2.0	1.1	1.5	.1
	Net growth	5.4	7.4	-4	.6	3.4	4.0	5.6	1.9	1.4	3.7
White oak	Accretion	2.5	2.6	.6	.5	.6	4.7	3.2	.6	.5	.7
	Ingrowth	.1	.1	0	0	0	.1	0	0	.3	0
	Mortality	1.0	3.1	4.4	.6	.3	.6	3.3	7.1	.6	.7
	Net growth	1.6	-4	-3.8	-1	.3	4.2	-1	-6.5	.2	0
Yellow birch	Accretion	1.8	1.3	.8	1.3	2.6	T	.2	T	.1	.2
	Ingrowth	.1	.1	0	.5	.3	0	0	0	.1	.1
	Mortality	.6	1.8	1.2	.5	.6	T	T	T	T	T
	Net growth	1.3	-4	-4	1.3	2.3	0	.2	0	.2	.2

Table 14a. Canopy stand density (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

SPECIES	All Sites						Moist					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	3.5	1.5	1.5	2.0	2.2	2.9	10.3	4.3	4.9	6.7	8.0	9.2
Red maple	33.0	18.5	11.0	15.2	12.9	10.2	58.4	48.4	26.4	30.7	23.9	22.7
Bitternut hickory	.1	.1	.1	.1	.1	N	N	N	N	N	N	N
Mockernut hickory	3.3	1.5	1.5	.7	.1	.1	N	N	.6	.6	N	N
Pignut hickory	5.2	2.4	2.5	2.4	.8	.7	.9	.6	.6	N	N	N
Shagbark hickory	3.1	1.9	1.6	1.5	.8	.5	3.4	1.8	3.1	3.1	2.5	1.8
Northern red oak	35.9	26.0	23.6	19.7	16.4	15.9	24.9	19.6	18.4	14.7	11.6	11.0
Black oak	14.4	10.1	10.6	7.9	7.6	7.1	2.6	2.5	1.8	1.2	1.2	1.2
Scarlet oak	14.4	10.8	9.5	7.8	6.0	5.0	9.5	4.9	3.7	2.5	2.5	2.5
White oak	20.7	12.2	8.8	4.8	4.0	3.5	6.9	4.3	1.8	1.8	1.8	1.8
Chestnut oak	13.4	11.1	10.4	3.9	2.7	2.2	9.5	6.7	6.7	2.5	.6	N
Yellow birch	11.9	6.6	6.6	7.2	5.3	5.3	28.4	11.6	19.6	21.5	15.3	12.9
Black birch	31.3	17.3	14.9	15.4	12.3	10.5	13.7	9.2	12.9	12.9	11.0	11.0
Paper birch	.3	.2	.2	.3	.1	N	N	N	N	N	N	N
Beech	.7	.4	.4	.6	.9	1.1	.9	.6	.6	.6	.6	N
White ash	13.9	6.6	3.5	4.9	3.6	2.6	18.9	11.0	8.6	12.3	8.6	5.5
Black ash	.3	.1	N	.2	.2	.2	1.7	.6	N	N	N	N
Basswood	.7	.4	.1	.1	.1	N	1.7	.6	N	N	N	N
Tulip	6.3	5.7	3.8	4.1	4.2	4.1	6.0	4.9	3.7	3.7	3.7	3.7
American elm	.3	.5	.8	.3	.1	.1	1.7	1.8	3.7	.6	N	N
Bigtooth aspen	14.1	6.6	.3	.1	N	N	41.2	19.0	N	N	N	N
Quaking aspen	.1	.1	N	N	N	N	.9	.6	N	N	N	N
Tupelo	.3	.1	.1	.1	.1	.2	N	N	N	N	N	.6
Black locust	N	N	.1	.1	.1	.1	N	N	N	N	N	N
Butternut	1.3	.2	N	N	N	N	.9	N	N	N	N	N
Black cherry	1.3	.3	N	N	N	N	5.2	.6	N	N	N	N
Sassafras	.7	.7	.2	.2	N	N	.9	N	N	N	N	N
White pine	.1	.1	N	N	N	N	N	N	N	N	N	N
MAJOR SPECIES	230.5	142.0	112.1	99.6	80.6	72.3	248.3	153.9	117.1	115.3	91.4	84.0
Chestnut	.1	N	N	N	N	N	N	N	N	N	N	N
Flowering dogwood	.4	N	.3	.1	N	N	N	N	N	.6	N	N
Blue-beech	.1	N	.3	N	N	N	N	N	.6	N	N	N
Hophornbeam	.9	.3	.2	N	N	N	.9	.6	.6	N	N	N
Gray birch	35.7	6.4	.1	N	N	N	60.1	4.9	.6	N	N	N
Redcedar	.1	N	N	N	N	N	N	N	N	N	N	N
MINOR SPECIES	37.4	6.7	.9	.1	N	N	61.0	5.5	1.8	.6	N	N
ALL SPECIES	267.9	148.7	113.0	99.7	80.6	72.3	309.3	159.4	118.9	115.9	91.4	84.0

Table 14b. Canopy stand density (stems/A) during 1927-87. Average over all tracts. All sites includes wet. N indicates no stems present.

SPECIES	Medium Moist						Dry					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	2.7	1.2	1.0	1.3	1.3	1.9	.7	N	N	N	N	.7
Red maple	29.1	12.7	8.6	12.0	10.4	7.1	25.7	3.6	.7	1.4	2.9	1.4
Bitternut hickory	.2	.1	.1	.1	.1	N	N	N	N	N	N	N
Mockernut hickory	4.0	2.1	1.9	.7	.1	.1	3.1	.7	.7	.7	N	N
Pignut hickory	5.0	2.5	2.5	2.5	.9	.9	10.1	4.3	5.1	5.1	1.4	.7
Shagbark hickory	3.7	2.2	1.6	1.5	.6	.3	.7	.7	N	N	N	N
Northern red oak	40.5	29.5	26.5	21.6	17.6	16.9	27.2	21.0	19.6	19.6	18.8	19.6
Black oak	13.1	10.1	10.1	7.4	7.6	7.1	30.4	21.0	25.4	19.6	16.7	15.2
Scarlet oak	13.9	11.1	9.8	7.8	5.8	4.4	21.0	18.1	16.7	15.2	12.3	11.6
White oak	21.4	12.4	9.8	5.3	4.1	3.7	30.4	22.5	13.8	6.5	6.5	5.1
Chestnut oak	17.0	13.9	12.4	4.0	2.5	2.4	2.3	4.3	6.5	5.8	6.5	4.3
Yellow birch	10.8	7.0	4.9	5.3	4.1	4.6	1.6	N	N	N	N	N
Black birch	33.7	21.0	18.1	18.2	14.5	11.3	37.4	11.6	4.3	7.2	5.1	8.0
Paper birch	.4	.3	.3	.4	.1	N	N	N	N	N	N	N
Beech	.6	.3	.4	.6	.9	1.2	.7	.7	N	.7	1.4	2.2
White ash	14.8	6.2	3.0	3.6	2.7	1.9	5.4	3.6	N	.7	N	N
Black ash	N	N	N	N	N	N	N	N	N	N	N	N
Basswood	.6	.4	.1	.1	.1	N	N	N	N	N	N	N
Tulip	7.7	7.1	4.6	5.0	5.0	4.9	.7	.7	.7	.7	1.4	1.4
American elm	N	N	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	8.5	4.6	.4	.1	N	N	12.5	2.9	N	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N	N	N
Tupelo	.4	.1	.1	.1	.1	.1	N	N	N	N	N	N
Black locust	N	N	N	N	N	N	N	N	.7	.7	.7	.7
Butternut	1.3	.3	N	N	N	N	1.6	N	N	N	N	N
Black cherry	.6	.3	N	N	N	N	.7	N	N	N	N	N
Sassafras	.8	1.0	.3	.3	N	N	N	N	N	N	N	N
White pine	.2	.1	N	N	N	N	N	N	N	N	N	N
MAJOR SPECIES	230.9	146.7	116.7	98.3	78.8	68.9	212.5	115.9	94.2	84.1	73.9	71.0
Chestnut	N	N	N	N	N	N	.7	N	N	N	N	N
Flowering dogwood	.6	N	.4	N	N	N	N	N	N	N	N	N
Blue-beech	.2	N	.3	N	N	N	N	N	N	N	N	N
Hophornbeam	1.2	.3	.1	N	N	N	N	N	N	N	N	N
Gray birch	32.2	7.4	N	N	N	N	28.0	4.3	N	N	N	N
Redcedar	N	N	N	N	N	N	.7	N	N	N	N	N
MINOR SPECIES	34.1	7.7	.9	N	N	N	29.5	4.3	N	N	N	N
ALL SPECIES	265.0	154.4	117.6	98.3	78.8	68.9	242.0	120.3	94.2	84.1	73.9	71.0

Table 15a. Canopy basal area ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

Species	All Sites						Moist					
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	1987
Sugar maple	.6	.6	.8	1.1	1.4	2.0	2.7	2.1	2.9	3.9	4.8	6.4
Red maple	4.0	5.1	4.5	6.3	6.6	6.6	7.9	14.8	12.4	16.1	14.6	17.1
Bitternut hickory	T	T	T	T	T	N	N	N	N	N	N	N
Mockernut hickory	.5	.4	.5	.3	T	T	N	N	T	T	N	N
Pignut hickory	.6	.9	1.2	1.5	.4	.4	.2	.2	.3	N	N	N
Shagbark hickory	.4	.4	.5	.6	.4	.4	.5	.4	1.0	1.3	1.4	1.3
Northern red oak	8.0	10.8	18.1	19.7	20.3	23.4	5.7	8.5	17.1	17.6	17.3	20.4
Black oak	2.9	4.3	7.9	8.1	9.0	9.8	1.6	1.6	2.5	2.6	3.0	3.2
Scarlet oak	3.2	4.4	6.5	6.3	5.8	5.6	2.0	2.4	3.2	1.9	2.2	2.6
White oak	3.5	4.4	5.2	3.7	3.8	4.0	1.0	1.2	1.1	1.4	1.6	1.9
Chestnut oak	4.1	5.4	7.2	3.0	2.4	2.3	3.5	4.1	6.0	2.7	.7	N
Yellow birch	2.1	2.8	3.5	3.9	3.2	3.6	6.1	6.1	10.9	12.4	9.4	9.3
Black birch	5.8	6.5	7.7	8.9	8.7	8.5	4.5	6.1	9.4	11.2	11.8	13.0
Paper birch	T	T	.1	.1	T	N	N	N	N	N	N	N
Beech	T	.1	.2	.3	.6	.8	.2	.3	.6	.7	.9	N
White ash	1.8	1.8	1.6	2.2	2.1	1.9	2.7	3.2	3.9	5.4	4.7	3.6
Black ash	T	T	N	T	T	T	.4	.2	N	N	N	N
Basswood	.1	.2	T	.1	.1	N	.7	.5	N	N	N	N
Tulip	1.7	2.6	3.3	4.3	5.9	6.7	2.3	2.9	4.5	5.7	7.4	7.6
American elm	T	.1	.3	T	T	T	T	.5	1.4	.2	N	N
Bigtooth aspen	2.2	1.6	T	T	N	N	6.2	4.2	N	N	N	N
Quaking aspen	T	T	N	N	N	N	T	T	N	N	N	N
Tupelo	T	T	T	T	T	T	N	N	N	N	N	.1
Black locust	N	N	T	T	T	T	N	N	N	N	N	N
Butternut	.2	T	N	N	N	N	.2	N	N	N	N	N
Black cherry	T	T	N	N	N	N	.3	T	N	N	N	N
Sassafras	T	.1	T	T	N	N	.2	N	N	N	N	N
White pine	.1	T	N	N	N	N	N	N	N	N	N	N
MAJOR SPECIES	42.2	52.9	69.4	70.8	71.0	76.5	48.9	59.5	77.5	83.3	79.7	86.5
Chestnut	T	N	N	N	N	N	N	N	N	N	N	N
Flowering dogwood	T	N	T	T	N	N	N	N	N	.1	N	N
Blue-beech	T	N	T	N	N	N	N	N	T	N	N	N
Hophornbeam	T	T	T	N	N	N	.3	.2	.2	N	N	N
Gray birch	2.1	.7	T	N	N	N	3.6	.5	.2	N	N	N
Redcedar	T	N	N	N	N	N	N	N	N	N	N	N
MINOR SPECIES	2.2	.7	.1	T	N	N	3.9	.7	.4	.1	N	N
ALL SPECIES	44.4	53.6	69.5	70.9	71.0	76.5	52.7	60.2	77.9	83.4	79.7	86.5



Table 15b. Canopy basal area ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

Species	Medium Moist						Dry					1987
	1927	1937	1957	1967	1977	1987	1927	1937	1957	1967	1977	
Sugar maple	.3	.4	.5	.7	.9	1.4	T	N	N	N	N	.2
Red maple	3.7	3.1	3.2	4.7	4.9	4.1	1.9	.6	.2	.3	2.7	2.9
Bitternut hickory	T	T	T	T	T	N	N	N	N	N	N	N
Mockernut hickory	.7	.5	.7	.4	T	T	.4	.3	.4	.4	N	N
Pignut hickory	.5	1.0	1.3	1.7	.5	.5	1.3	1.4	1.9	2.2	.9	.6
Shagbark hickory	.4	.5	.6	.5	.2	.2	T	T	N	N	N	N
Northern red oak	9.6	12.6	20.1	21.8	22.4	25.5	3.7	6.6	12.6	15.2	16.9	20.6
Black oak	2.6	4.4	7.9	8.0	9.3	10.0	5.0	7.8	15.6	16.3	16.4	18.2
Scarlet oak	3.3	4.7	6.7	6.6	5.8	5.2	3.6	6.1	10.1	11.0	11.3	12.1
White oak	3.7	4.8	6.0	4.3	4.3	4.5	4.9	6.8	6.9	4.5	4.9	4.8
Chestnut oak	5.1	6.7	8.6	3.3	2.7	2.9	.6	1.6	3.0	2.8	3.1	2.5
Yellow birch	1.6	2.7	2.5	2.7	2.5	3.0	.5	N	N	N	N	N
Black birch	6.3	7.4	8.6	9.8	9.4	8.6	4.7	3.4	2.3	3.7	2.9	4.6
Paper birch	T	.1	.2	.2	.1	N	N	N	N	N	N	N
Beech	T	T	.2	.3	.5	1.0	.1	.2	N	.2	.5	1.1
White ash	2.0	1.7	1.4	1.7	1.7	1.6	.6	.7	N	.1	N	N
Black ash	N	N	N	N	N	N	N	N	N	N	N	N
Basswood	T	.1	.1	.2	.2	N	N	N	N	N	N	N
Tulip	1.9	3.1	3.8	4.9	6.7	7.9	.1	.2	.4	.6	1.0	1.4
American elm	N	N	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	1.5	1.3	.1	T	N	N	1.3	.6	N	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N	N	N
Tupelo	T	T	T	T	.1	.1	N	N	N	N	N	N
Black locust	N	N	N	N	N	N	N	N	.2	.3	.4	.5
Butternut	.2	T	N	N	N	N	T	N	N	N	N	N
Black cherry	T	T	N	N	N	N	T	N	N	N	N	N
Sassafras	T	.2	T	T	N	N	N	N	N	N	N	N
White pine	0.2	0.1	N	N	N	N	N	N	N	N	N	N
MAJOR SPECIES	43.9	55.7	72.7	72.0	72.4	76.8	28.9	36.4	53.4	57.5	61.0	69.4
Chestnut	N	N	N	N	N	N	T	N	N	N	N	N
Flowering dogwood	T	N	T	N	N	N	N	N	N	N	N	N
Blue-beech	T	N	T	N	N	N	N	N	N	N	N	N
Hophornbeam	T	T	T	N	N	N	N	N	N	N	N	N
Gray birch	1.9	.8	N	N	N	N	1.5	.3	N	N	N	N
Redcedar	N	N	N	N	N	N	.2	N	N	N	N	N
MINOR SPECIES	2.0	.8	T	N	N	N	1.7	.3	N	N	N	N
ALL SPECIES	45.9	56.6	72.8	72.0	72.4	76.8	30.6	36.7	53.4	57.5	61.0	69.4

Table 16a. Periodic canopy mortality (stems/A) during 1927-87. Average over all tracts. All sites includes wet.  
N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	2.1	.6	.2	.4	.2	5.2	1.2	.6	1.2	.6
Red maple	19.8	11.1	.9	5.1	4.7	28.4	27.6	.6	9.2	5.5
Bitternut hickory	0	0	0	0	.1	N	N	N	N	N
Mockernut hickory	1.7	.4	.8	.7	0	N	0	0	.6	N
Pignut hickory	3.3	.5	.3	1.6	.1	0	0	.6	N	N
Shagbark hickory	1.4	.9	.4	.7	.3	1.7	.6	.6	.6	.6
Northern red oak	8.1	5.7	4.6	3.7	.7	2.6	3.7	4.3	3.1	.6
Black oak	4.2	1.5	2.8	.6	.5	0	.6	.6	0	0
Scarlet oak	2.0	2.3	2.2	1.9	1.0	2.6	1.2	1.2	0	0
White oak	8.8	5.4	4.2	1.0	.6	3.4	2.5	0	0	0
Chestnut oak	2.2	2.9	6.7	1.4	.6	.9	.6	4.3	1.8	.6
Yellow birch	8.4	3.0	1.1	2.6	1.6	21.5	3.7	1.8	8.0	4.3
Black birch	15.3	7.4	2.0	4.5	3.2	5.2	1.2	.6	3.1	.6
Paper birch	.1	0	0	.2	.1	N	N	N	N	N
Beech	.3	.1	0	0	.1	0	0	0	0	.6
White ash	6.5	3.8	.2	1.5	1.2	6.0	3.7	.6	3.7	3.7
Black ash	.1	.1	0	0	0	.9	.6	N	N	N
Basswood	.3	.3	0	0	.1	.9	.6	N	N	N
Tulip	.9	2.2	0	0	.6	2.6	1.8	0	0	.6
American elm	.3	.1	.5	.2	0	1.7	0	3.1	.6	N
Bigtooth aspen	5.6	6.4	.2	.1	N	14.6	19.0	N	N	N
Quaking aspen	0	.1	N	N	N	0	.6	N	N	N
Tupelo	.1	0	0	0	0	N	N	N	N	0
Black locust	N	0	0	0	0	N	N	N	N	N
Butternut	1.2	.2	N	N	N	.9	N	N	N	N
Black cherry	.9	.3	N	N	N	4.3	.6	N	N	N
Sassafras	.3	.5	0	.2	N	.9	N	N	N	N
White pine	0	.1	N	N	N	N	N	N	N	N
MAJOR SPECIES	93.9	55.9	27.1	26.4	15.7	104.0	69.9	19.0	31.9	17.8
Chestnut	.1	N	N	N	N	N	N	N	N	N
Flowering dogwood	.4	0	.3	.1	N	N	N	0	.6	N
Blue-beech	.1	0	.3	N	N	N	0	.6	N	N
Hophornbeam	.5	.2	.2	N	N	0	0	.6	N	N
Gray birch	28.0	6.3	.1	N	N	53.3	4.3	.6	N	N
Redcedar	.1	N	N	N	N	N	N	N	N	N
MINOR SPECIES	29.3	6.5	.9	.1	N	53.3	4.3	1.8	.6	N
ALL SPECIES	123.2	62.4	28.0	26.5	15.7	157.2	74.2	20.8	32.5	17.8

Table 16b. Periodic canopy mortality (stems/A) during 1927-87. Average over all tracts. All sites includes wet.  
 N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	1.7	.6	.1	.3	.1	.8	N	N	N	0
Red maple	17.2	7.4	1.2	4.1	4.7	22.6	3.6	0	.7	1.4
Bitternut hickory	0	0	0	0	.1	N	N	N	N	N
Mockernut hickory	1.9	.6	1.2	.7	0	2.3	0	0	.7	N
Pignut hickory	3.3	.4	.3	1.6	0	6.2	1.4	0	3.6	.7
Shagbark hickory	1.7	1.0	.4	.9	.3	0	.7	N	N	N
Northern red oak	9.3	6.8	5.6	4.3	.9	8.6	3.6	.7	2.2	0
Black oak	3.9	1.6	2.8	.1	.4	9.3	2.2	5.8	3.6	1.4
Scarlet oak	1.5	2.4	2.1	2.2	1.3	3.1	3.6	4.3	2.9	.7
White oak	9.6	5.2	4.6	1.2	.6	10.1	10.9	8.0	1.4	1.4
Chestnut oak	2.9	3.9	8.6	1.5	.3	.8	1.4	1.4	.7	2.2
Yellow birch	7.1	3.6	1.2	1.8	1.3	1.6	N	N	N	N
Black birch	14.8	8.4	2.8	5.2	4.6	26.5	10.9	0	3.6	0
Paper birch	.2	0	0	.3	.1	N	N	N	N	N
Beech	.4	0	0	0	0	0	.7	0	0	0
White ash	7.7	3.9	.1	1.2	.9	2.3	3.6	0	.7	N
Black ash	N	N	N	N	N	N	N	N	N	N
Basswood	.2	.3	0	0	.1	N	N	N	N	N
Tulip	.8	2.8	0	0	.7	0	0	0	0	0
American elm	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	2.7	4.3	.3	.1	N	9.3	2.9	N	N	N
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	.2	0	0	0	0	N	N	N	N	N
Black locust	N	N	N	N	N	N	0	0	0	0
Butternut	1.2	.3	N	N	N	1.6	N	N	N	N
Black cherry	.2	.3	N	N	N	.8	N	N	N	N
Sassafras	.2	.7	0	.3	N	N	N	N	N	N
White pine	0	.1	N	N	N	N	N	N	N	N
MAJOR SPECIES	88.7	54.6	31.4	25.9	16.7	105.8	45.7	20.3	20.3	8.0
Chestnut	N	N	N	N	N	.8	N	N	N	N
Flowering dogwood	.6	0	.4	N	N	N	N	N	N	N
Blue-beech	.2	0	.3	N	N	N	N	N	N	N
Hophornbeam	.8	.3	.1	N	N	N	N	N	N	N
Gray birch	23.3	7.4	N	N	N	24.1	4.3	N	N	N
Redcedar	N	N	N	N	N	.8	N	N	N	N
MINOR SPECIES	24.9	7.7	.9	N	N	25.7	4.3	N	N	N
ALL SPECIES	113.5	62.3	32.3	25.9	16.7	131.5	50.0	20.3	20.3	8.0

Table 17a. Periodic canopy ingrowth (stems/A) during 1927-87. Average over all tracts. All sites includes wet. T represents less than 0.1 stem/A. N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.1	.6	.7	.6	.9	0	1.8	2.5	2.5	1.8
Red maple	2.5	3.6	5.1	2.8	2.0	6.0	5.5	4.9	2.5	4.3
Mockernut hickory	.4	.4	0	T	0	0	.6	0	0	0
Pignut hickory	.1	.6	.2	0	0	0	0	0	0	0
Shagbark hickory	.1	.6	.3	0	0	.9	1.8	.6	0	0
Northern red oak	2.7	3.3	.7	.4	.2	2.6	2.5	.6	0	0
Black oak	1.0	2.0	T	.3	0	0	0	0	0	0
Scarlet oak	.4	1.0	.5	T	0	0	0	0	0	0
White oak	1.8	2.0	.2	.2	T	1.7	0	0	0	0
Chestnut oak	.4	2.2	.2	.2	T	.9	.6	0	0	0
Yellow birch	1.2	3.0	1.7	.7	1.6	.9	11.6	3.7	1.8	1.8
Black birch	2.4	5.0	2.5	1.4	1.4	0	4.9	.6	1.2	.6
Paper birch	0	0	T	0	0	N	N	N	N	N
Beech	.1	T	.2	.3	.3	0	0	0	0	0
White ash	.5	.7	1.6	.2	.2	.9	1.2	4.3	0	.6
Black ash	0	0	.2	0	0	0	0	0	0	0
Basswood	.1	0	0	0	0	0	0	0	N	N
Tulip	.3	.3	.3	T	.5	0	.6	0	0	.6
American elm	0	.4	0	0	0	0	1.8	0	0	0
Bigtooth aspen	.1	T	0	0	N	0	0	N	N	N
Tupelo	0	0	0	0	T	0	0	0	0	.6
Black locust	0	T	0	0	0	N	N	N	N	N
MAJOR SPECIES	14.4	26.0	14.6	7.4	7.4	13.7	33.1	17.2	8.0	10.4
Flowering dogwood	0	.3	T	0	0	0	0	.6	0	0
Blue-beech	0	.3	0	0	0	0	.6	0	0	0
Hophornbeam	0	T	0	0	0	0	0	0	0	0
Gray birch	.4	0	0	0	0	0	0	0	N	N
MINOR SPECIES	.4	.7	T	0	0	0	.6	.6	0	0
ALL SPECIES	14.8	26.7	14.7	7.4	7.4	13.7	33.7	17.8	8.0	10.4

Table 17b. Periodic canopy ingrowth (stems/A) during 1927-87. Average over all tracts. All sites includes wet. T represents less than 0.1 stem/A. N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.2	.4	.4	.3	.7	0	0	0	0	.7
Red maple	2.1	3.3	4.6	2.5	1.5	.8	.7	.7	2.2	0
Mockernut hickory	.6	.4	0	.1	0	0	0	0	0	0
Pignut hickory	0	.4	.3	0	0	.8	2.2	0	0	0
Shagbark hickory	0	.4	.3	0	0	0	0	0	N	N
Northern red oak	3.1	3.9	.7	.3	.1	1.6	2.2	.7	1.4	.7
Black oak	1.2	1.6	.1	.3	0	1.6	6.5	0	.7	0
Scarlet oak	.2	1.0	.1	.1	0	1.6	2.2	2.9	0	0
White oak	1.5	2.5	.1	0	.1	3.1	2.2	.7	1.4	0
Chestnut oak	.4	2.4	.1	0	.1	0	3.6	.7	1.4	0
Yellow birch	1.5	1.5	1.6	.6	1.8	0	0	0	0	0
Black birch	3.1	5.5	3.0	1.5	1.3	1.6	3.6	2.9	1.4	2.9
Paper birch	0	0	.1	0	0	N	N	N	N	N
Beech	.2	.1	.1	.3	.3	0	0	.7	.7	.7
White ash	.4	.6	.7	.3	.1	.8	0	.7	0	0
Black ash	0	0	N	0	0	N	N	0	0	N
Basswood	.2	0	0	0	0	N	N	N	N	N
Tulip	.4	.3	.4	0	.6	0	0	0	.7	0
American elm	0	0	0	0	0	0	N	N	N	N
Bigtooth aspen	.2	.1	0	0	N	0	N	N	N	N
Tupelo	0	0	0	0	0	0	0	0	0	0
Black locust	N	N	N	N	N	0	.7	0	0	0
MAJOR SPECIES	15.2	24.6	13.0	6.4	6.8	11.7	23.9	10.1	10.1	5.1
Flowering dogwood	0	.4	0	0	0	0	0	0	0	0
Blue-beech	0	.3	0	0	0	0	0	0	0	0
Hophornbeam	0	.1	0	0	0	0	0	0	0	0
Gray birch	.4	0	0	0	N	.8	0	N	0	0
MINOR SPECIES	.4	.9	0	0	0	.8	0	0	0	0
ALL SPECIES	15.6	25.5	13.0	6.4	6.8	12.5	23.9	10.1	10.1	5.1



Table 18a. Periodic canopy basal area mortality ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.2	.1	T	T	T	.5	.4	T	.4	T
Red maple	1.6	2.8	.2	1.8	1.8	2.5	7.8	.6	4.7	2.4
Bitternut hickory	0	0	0	0	T	N	N	N	N	N
Mockernut hickory	.2	T	.3	.3	0	0	0	0	T	0
Pignut hickory	.2	.1	.1	1.1	T	0	0	.3	0	0
Shagbark hickory	.1	.1	.1	.2	T	.1	.1	.1	.2	.2
Northern red oak	.7	1.6	1.9	2.5	.7	.4	.8	2.7	3.1	.4
Black oak	.4	.4	1.2	.4	.6	0	T	.3	0	0
Scarlet oak	.2	.8	1.3	1.2	1	0	0	1.6	0	0
White oak	.8	1.2	2.1	.4	.3	.3	.5	0	0	0
Chestnut oak	.4	1.1	4.6	1	.4	T	.4	3.7	1.9	.7
Yellow birch	1.3	.8	.6	1.3	.7	4.7	1	1.4	4.6	2
Black birch	1.9	2.2	.7	1.9	1.6	.6	.6	.1	1.3	.4
Paper birch	T	0	0	T	T	N	N	N	N	N
Beech	T	T	0	0	.1	0	0	0	0	.9
White ash	.6	.7	T	.5	.6	.8	.5	T	1.3	2
Black ash	T	T	0	0	0	.2	.2	0	0	0
Basswood	T	.1	0	0	.1	.1	.5	0	0	0
Tulip	T	1	0	0	.8	.3	.9	0	0	1.4
American elm	T	T	.2	T	0	T	0	1.2	.2	0
Bigtooth aspen	.7	1.6	T	T	0	1.8	4.2	0	0	0
Quaking aspen	0	T	0	0	0	0	T	0	0	0
Tupelo	T	0	0	0	0	N	N	N	N	N
Butternut	.1	T	0	0	0	.2	0	0	0	0
Black cherry	T	T	0	0	0	.2	T	0	0	0
Sassafras	T	.1	0	T	0	.2	0	0	0	0
White pine	0	T	0	0	0	N	N	N	N	N
MAJOR SPECIES	9.7	15.2	13.3	13.0	9.0	13.1	18.9	12.4	17.7	10.4
Chestnut	T	0	0	0	0	N	N	N	N	N
Flowering dogwood	T	0	T	T	0	0	0	0	.1	0
Blue-beech	T	0	T	0	0	0	0	T	0	0
Hophornbeam	T	T	T	0	0	0	0	.2	0	0
Gray birch	1.5	.6	T	0	0	3.1	.4	.2	0	0
Redcedar	T	0	0	0	0	N	N	N	N	N
MINOR SPECIES	1.6	.7	.1	T	0	3.1	.4	.4	.1	0
ALL SPECIES	11.3	15.8	13.4	13.0	9.0	16.2	19.3	12.8	17.9	10.4

Table 18b. Periodic canopy basal area mortality ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.2	.1	T	T	T	T	0	0	0	0
Red maple	1.4	1.5	.2	1.2	1.8	1.6	.6	0	.2	.4
Bitternut hickory	0	0	0	0	T	N	N	N	N	N
Mockernut hickory	.3	T	.4	.4	0	.2	0	0	.4	0
Pignut hickory	.2	.1	T	1.3	0	.4	.5	0	1.4	.3
Shagbark hickory	.1	.2	.2	.3	T	0	T	0	0	0
Northern red oak	.9	2.1	2.1	2.8	1	.6	.8	.2	1.2	0
Black oak	.4	.4	1.3	.2	.7	.7	.3	1.9	2.2	.8
Scarlet oak	.2	.9	1.1	1.6	1.3	.3	.5	1.6	1	.9
White oak	.9	1.1	2.4	.5	.4	1	2.4	3.1	.6	.6
Chestnut oak	.6	1.5	5.8	.9	.3	T	.2	1	.8	.9
Yellow birch	.7	1	.5	.8	.5	.5	0	0	0	0
Black birch	2	2.6	1	2	2.3	2.5	2.4	0	2	0
Paper birch	T	0	0	.1	.1	N	N	N	N	N
Beech	T	0	0	0	0	0	.2	0	0	0
White ash	.6	.8	T	.4	.3	.2	.7	0	.1	0
Black ash	N	N	N	N	N	N	N	N	N	N
Basswood	T	T	0	0	.2	N	N	N	N	N
Tulip	T	1.2	0	0	.9	0	0	0	0	0
American elm	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	.4	1.2	T	T	0	.9	.6	0	0	0
Quaking aspen	N	N	N	N	N	N	N	N	N	N
Tupelo	T	0	0	0	0	N	N	N	N	N
Butternut	.1	T	0	0	0	T	0	0	0	0
Black cherry	T	T	0	0	0	T	0	0	0	0
Sassafras	T	.1	0	T	0	N	N	N	N	N
White pine	0	.1	0	0	0	N	N	N	N	N
MAJOR SPECIES	9.1	15.4	15.1	12.6	9.9	9	9.4	7.8	9.9	3.9
Chestnut	N	N	N	N	N	T	0	0	0	0
Flowering dogwood	T	0	T	0	0	N	N	N	N	N
Blue-beech	T	0	T	0	0	N	N	N	N	N
Hophornbeam	T	T	T	0	0	N	N	N	N	N
Gray birch	1.3	.8	0	0	0	1.3	.3	0	0	0
Redcedar	N	N	N	N	N	.2	0	0	0	0
MINOR SPECIES	1.3	.8	T	0	0	1.5	.3	0	0	0
ALL SPECIES	10.4	16.2	15.2	12.6	9.9	10.5	9.7	7.8	9.9	3.9

Table 19a. Canopy basal area ingrowth ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet site. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	All Sites					Moist				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	T	.1	.1	.1	.3	0	.4	.6	.4	.8
Red maple	.4	1.0	1.3	1.1	.8	.9	2.1	2.0	.7	2.2
Mockernut hickory	T	T	0	T	0	0	T	0	0	0
Pignut hickory	T	.1	T	0	0	N	N	N	N	N
Shagbark hickory	T	.1	T	0	0	.2	.4	.2	0	0
Northern red oak	.4	1.2	.2	.1	T	.5	1.2	T	0	0
Black oak	.1	.7	T	.1	0	N	N	N	N	N
Scarlet oak	T	.3	.2	T	0	N	N	N	N	N
White oak	.3	.5	T	T	T	.2	0	0	0	0
Chestnut oak	T	.7	T	T	T	.2	.3	0	0	0
Yellow birch	.2	1.0	.6	.3	.7	.2	4.8	1.7	.5	.8
Black birch	.4	1.6	.9	.5	.5	0	1.9	.4	.6	T
Paper birch	0	0	T	0	0	N	N	N	N	N
Beech	T	T	T	T	.1	N	N	N	N	N
White ash	T	.2	.4	.1	.1	T	.2	1.0	0	.6
Black ash	0	0	T	0	0	0	0	0	0	0
Basswood	T	0	0	0	0	0	0	0	N	N
Tulip	T	.1	.1	T	.2	0	.4	0	0	T
American elm	0	.1	0	0	0	0	.8	0	0	0
Bigtooth aspen	T	T	0	0	N	0	0	N	N	N
Tupelo	0	0	0	0	T	0	0	0	0	.1
Black locust	0	T	0	0	0	N	N	N	N	N
MAJOR SPECIES	2.3	8.0	4.2	2.7	2.8	2.3	12.6	6.0	2.1	4.6
Flowering dogwood	0	T	T	0	0	0	0	.1	0	0
Blue-beech	0	T	0	0	0	0	T	0	0	0
Hophornbeam	0	T	0	0	0	0	0	0	0	0
Gray birch	T	0	0	0	0	0	0	0	N	N
MINOR SPECIES	T	T	T	0	0	0	T	.1	0	0
ALL SPECIES	2.3	8.1	4.2	2.7	2.8	2.3	12.6	6.2	2.1	4.6

Table 19b. Canopy basal area ingrowth ( $\text{ft}^2/\text{A}$ ) during 1927-87. Average over all tracts. All sites includes wet site. T represents less than  $0.1 \text{ ft}^2/\text{A}$ . N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987	1927 -1937	1937 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	T	T	T	T	.3	0	0	0	0	.2
Red maple	.3	.8	1.2	.8	.5	T	.2	.1	2.5	0
Mockernut hickory	T	T	0	T	0	N	N	N	N	N
Pignut hickory	0	T	T	0	0	T	.6	0	0	0
Shagbark hickory	0	T	T	0	0	N	N	N	N	N
Northern red oak	.5	1.4	.3	.1	T	.2	.6	.2	.3	.1
Black oak	.2	.6	T	.2	0	.2	.2	0	.2	0
Scarlet oak	T	.2	T	.1	0	.3	.9	1.1	0	0
White oak	.2	.6	T	0	T	.7	.6	.3	.6	0
Chestnut oak	T	.8	T	0	T	0	1.0	.4	.7	0
Yellow birch	.2	.3	.5	.3	.7	N	N	N	N	N
Black birch	.5	1.6	1.0	.4	.4	.2	1.2	1.0	.8	1.3
Paper birch	0	0	T	0	N	N	N	N	N	N
Beech	T	T	T	T	.1	0	0	.2	.2	.3
White ash	T	.2	.2	.2	T	.2	0	.1	N	N
Black ash	0	0	N	0	0	N	N	0	0	N
Basswood	T	0	0	0	0	N	N	N	N	N
Tulip	T	.1	.2	0	.2	0	0	0	.2	0
American elm	N	N	N	N	N	0	N	N	N	N
Bigtooth aspen	T	T	0	0	N	0	0	N	N	N
Tupelo	N	N	N	N	N	N	N	N	N	N
Black locust	N	N	N	N	N	0	.2	0	0	0
MAJOR SPECIES	2.3	7.1	3.6	2.3	2.5	1.9	7.4	3.4	5.6	1.9
Flowering dogwood	0	T	0	0	0	0	0	0	0	0
Blue-beech	0	T	0	0	0	0	0	0	0	0
Hophornbeam	0	T	0	0	0	0	0	0	0	0
Gray birch	T	0	0	0	N	T	0	N	0	0
MINOR SPECIES	T	T	0	0	0	T	0	0	0	0
ALL SPECIES	2.4	7.2	3.6	2.3	2.5	1.9	7.4	3.4	5.6	1.9

Table 20a. Stand density (stems/A) during 1926-87 of burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	All Sites						Moist					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
Sugar maple	73.1	29.2	119.5	117.6	83.3	77.6	137.9	128.1	118.2	128.1	108.4	98.5
Red maple	78.2	22.3	183.1	164.0	144.9	124.0	54.2	24.6	64.0	73.9	49.3	59.1
Bitternut hickory	N	N	1.9	.6	N	N	N	N	N	N	N	N
Mockernut hickory	5.1	N	12.1	7.0	3.2	3.8	N	N	N	N	N	N
Pignut hickory	85.8	5.1	95.4	47.7	24.8	21.0	N	N	N	N	N	N
Shagbark hickory	6.4	.6	2.5	3.8	2.5	1.3	N	N	N	N	N	N
Northern red oak	55.9	12.1	117.6	75.0	33.7	34.3	34.5	14.8	34.5	34.5	29.6	14.8
Black oak	25.4	7.6	47.0	31.2	26.1	18.4	14.8	4.9	9.9	14.8	14.8	14.8
Scarlet oak	19.7	2.5	45.1	24.8	12.7	10.8	14.8	4.9	54.2	24.6	14.8	9.9
White oak	62.3	11.4	86.5	33.1	19.7	14.6	9.9	9.9	24.6	19.7	14.8	9.9
Chestnut oak	67.4	12.7	153.8	81.4	50.2	45.1	29.6	4.9	73.9	44.3	19.7	19.7
Yellow birch	51.5	19.1	54.7	43.2	39.4	36.2	98.5	88.7	197.0	162.6	133.0	113.3
Black birch	73.1	24.2	230.1	165.9	104.3	94.1	N	N	9.9	4.9	N	4.9
Beech	10.8	3.2	22.3	20.3	15.9	17.2	N	N	N	N	N	N
White ash	62.3	9.5	22.9	8.3	4.5	2.5	44.3	29.6	9.9	4.9	4.9	4.9
Black ash	.6	N	N	N	N	N	4.9	N	N	N	N	N
Basswood	.6	N	N	N	N	N	N	N	N	N	N	N
Tulip	7.6	2.5	51.5	22.9	18.4	14.6	19.7	4.9	14.8	14.8	9.9	9.9
American elm	N	N	1.3	.6	.6	N	N	N	9.9	4.9	4.9	N
Bigtooth aspen	7.6	N	3.8	.6	.6	.6	N	N	N	N	N	N
Tupelo	2.5	.6	4.5	1.3	1.3	1.3	19.7	4.9	34.5	9.9	9.9	9.9
Butternut	5.7	N	3.2	1.9	1.9	.6	N	N	N	N	N	N
Black cherry	3.2	N	12.7	3.2	1.3	1.3	N	N	4.9	N	N	N
Sassafras	15.3	N	36.2	15.9	13.4	10.8	N	N	39.4	34.5	29.6	29.6
White pine	N	N	1.9	1.9	1.9	1.9	N	N	N	N	N	N
MAJOR SPECIES	720.3	162.7	1309.6	872.2	604.6	532.1	482.8	320.2	699.5	576.4	443.3	399.0
Chestnut	N	N	2.5	4.5	10.2	8.3	N	N	9.9	14.8	9.9	N
Flowering dogwood	112.5	.6	183.1	120.2	80.1	3.8	14.8	N	9.9	4.9	4.9	N
Blue-beech	84.6	N	73.7	28.0	16.5	14.6	93.6	N	73.9	29.6	9.9	4.9
Shadbush	.6	N	.6	N	N	N	N	N	4.9	N	N	N
Hophornbeam	49.0	N	36.2	8.9	2.5	7.0	34.5	N	9.9	4.9	N	N
Gray birch	14.6	N	3.2	.6	.6	.6	N	N	4.9	4.9	4.9	4.9
Redcedar	20.3	N	N	N	N	N	N	N	N	N	N	N
MINOR SPECIES	281.6	.6	299.4	162.1	110.0	34.3	142.9	N	113.3	59.1	29.6	9.9
ALL SPECIES	1001.9	163.4	1609.0	1034.3	714.6	566.4	625.6	320.2	812.8	635.5	472.9	408.9



Table 20b. Stand density (stems/A) during 1926-87 of burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	Medium Moist						Dry					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
Sugar maple	74.3	17.4	133.9	131.2	87.2	81.7	21.4	3.6	64.1	56.9	49.8	46.3
Red maple	67.0	24.8	172.5	154.1	139.4	122.0	138.8	10.7	309.6	266.9	234.9	177.9
Bitternut hickory	N	N	.9	N	N	N	N	N	7.1	3.6	N	N
Mockernut hickory	6.4	N	16.5	10.1	4.6	5.5	3.6	N	3.6	N	N	N
Pignut hickory	102.8	3.7	121.1	58.7	28.4	22.9	81.9	14.2	64.1	39.1	28.5	28.5
Shagbark hickory	7.3	.9	3.7	5.5	3.7	1.8	7.1	N	N	N	N	N
Northern red oak	57.8	12.8	117.4	73.4	27.5	32.1	64.1	7.1	177.9	110.3	60.5	56.9
Black oak	30.3	10.1	61.5	38.5	33.0	22.9	14.2	N	17.8	14.2	7.1	3.6
Scarlet oak	18.3	2.8	40.4	20.2	10.1	10.1	28.5	N	56.9	42.7	21.4	14.2
White oak	74.3	13.8	85.3	29.4	16.5	14.7	53.4	3.6	135.2	56.9	35.6	17.8
Chestnut oak	34.9	5.5	74.3	38.5	30.3	29.4	220.6	46.3	519.6	274.0	149.5	124.6
Yellow birch	52.3	11.0	39.4	29.4	28.4	26.6	14.2	N	10.7	10.7	14.2	17.8
Black birch	92.7	31.2	300.9	215.6	130.3	108.3	49.8	14.2	113.9	89.0	78.3	103.2
Beech	15.6	4.6	31.2	28.4	22.0	22.0	N	N	3.6	3.6	3.6	10.7
White ash	55.0	2.8	23.9	6.4	2.8	.9	103.2	21.4	28.5	17.8	10.7	7.1
Black ash	N	N	N	N	N	N	N	N	N	N	N	N
Basswood	.9	N	N	N	N	N	N	N	N	N	N	N
Tulip	7.3	2.8	69.7	30.3	24.8	19.3	N	N	7.1	N	N	N
American elm	N	N	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	6.4	N	4.6	.9	.9	.9	17.8	N	3.6	N	N	N
Tupelo	N	N	N	N	N	N	N	N	N	N	N	N
Butternut	6.4	N	3.7	2.8	2.8	.9	7.1	N	3.6	N	N	N
Black cherry	3.7	N	15.6	2.8	.9	1.8	3.6	N	7.1	7.1	3.6	N
Sassafras	20.2	N	35.8	10.1	9.2	8.3	7.1	N	35.6	24.9	17.8	7.1
White pine	N	N	N	N	N	N	N	N	10.7	10.7	10.7	10.7
MAJOR SPECIES	734.0	144.0	1352.3	886.2	602.8	532.1	836.3	121.0	1580.1	1028.5	726.0	626.3
Chestnut	N	N	1.8	3.7	12.8	11.9	N	N	N	N	N	N
Flowering dogwood	149.5	.9	237.6	148.6	97.2	3.7	39.1	N	96.1	92.5	67.6	7.1
Blue-beech	98.2	N	83.5	30.3	19.3	16.5	24.9	N	35.6	17.8	10.7	14.2
Shadbush	N	N	N	N	N	N	3.6	N	N	N	N	N
Hophornbeam	62.4	N	47.7	8.3	.9	6.4	7.1	N	10.7	14.2	10.7	14.2
Gray birch	21.1	N	3.7	N	N	N	N	N	N	N	N	N
Redcedar	28.4	N	N	N	N	N	3.6	N	N	N	N	N
MINOR SPECIES	359.6	.9	374.3	190.8	130.3	38.5	78.3	N	142.3	124.6	89.0	35.6
ALL SPECIES	1093.6	145.0	1726.6	1077.1	733.0	570.6	914.6	121.0	1722.4	1153.0	814.9	661.9

Table 21a. Stand density (stems/A) during 1926-87 by diameter class on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

Diameter Class	All Sites						Moist					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
0.5 - 2.5	687.2	34.3	1281.6	661.8	362.4	237.8	339.9	83.7	645.3	423.6	221.7	142.9
2.6 - 4.5	160.8	40.1	224.4	224.4	181.2	136.7	128.1	78.8	69.0	103.4	133.0	123.2
4.6 - 6.5	64.2	25.4	40.7	75.0	75.7	74.4	54.2	59.1	14.8	39.4	39.4	39.4
6.6 - 8.5	37.5	24.2	15.9	22.9	37.5	44.5	34.5	29.6	24.6	14.8	19.7	29.6
8.6 - 10.5	28.0	14.0	18.4	15.3	19.7	23.5	29.6	19.7	34.5	24.6	24.6	24.6
10.6 - 12.5	15.3	14.6	7.0	12.1	12.1	16.5	29.6	34.5	4.9	14.8	9.9	19.7
12.6 - 14.5	3.8	5.1	8.3	6.4	8.3	11.4	9.9	14.8	9.9	4.9	9.9	14.8
14.6 - 16.5	3.2	3.8	5.7	6.4	5.1	7.0	N	N	4.9	N	4.9	4.9
16.6 - 18.5	0.6	0.6	3.8	3.8	6.4	4.5	N	N	4.9	4.9	4.9	4.9
> 18.5	1.3	1.3	3.2	6.4	6.4	10.2	N	N	N	4.9	4.9	4.9
Saplings	848.1	74.4	1506.0	886.2	543.5	374.4	468.0	162.6	714.3	527.1	354.7	266.0
Poles	129.7	63.6	75.0	113.2	132.9	142.4	118.2	108.4	73.9	78.8	83.7	93.6
Sawtimber	24.2	25.4	28.0	35.0	38.1	49.6	39.4	49.3	24.6	29.6	34.5	49.3
ALL CLASSES	1001.9	163.4	1609.0	1034.3	714.6	566.4	625.6	320.2	812.8	635.5	472.9	408.9

Table 21b. Stand density (stems/A) during 1926-87 by diameter class on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

Diameter Class	Medium Moist						Dry					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
0.5 - 2.5	789.9	30.3	1411.9	713.8	387.2	256.0	537.4	14.2	1231.3	629.9	366.5	234.9
2.6 - 4.5	166.1	34.9	219.3	222.0	180.7	129.4	163.7	32.0	355.9	320.3	217.1	174.4
4.6 - 6.5	61.5	20.2	33.0	71.6	74.3	75.2	81.9	21.4	89.0	113.9	106.8	96.1
6.6 - 8.5	33.0	22.0	13.8	15.6	31.2	33.9	56.9	28.5	17.8	56.9	74.7	96.1
8.6 - 10.5	22.9	12.8	17.4	14.7	17.4	24.8	46.3	14.2	10.7	10.7	24.9	17.8
10.6 - 12.5	9.2	11.9	7.3	11.9	12.8	14.7	28.5	10.7	7.1	10.7	10.7	21.4
12.6 - 14.5	3.7	4.6	7.3	7.3	7.3	11.0	N	N	10.7	3.6	10.7	10.7
14.6 - 16.5	4.6	5.5	7.3	7.3	6.4	7.3	N	N	N	7.1	N	7.1
16.6 - 18.5	0.9	0.9	4.6	4.6	7.3	5.5	N	N	N	N	3.0	N
> 18.5	1.8	1.8	4.6	8.3	8.3	12.8	N	N	N	N	N	3.6
Saplings	956.0	65.1	1631.2	935.8	567.9	385.3	701.1	46.3	1587.2	950.2	583.6	409.3
Poles	117.4	55.0	64.2	101.8	122.9	133.9	185.1	64.1	117.4	181.5	206.4	210.0
Sawtimber	20.2	24.8	31.2	39.4	42.2	51.4	28.5	10.7	17.8	21.4	24.9	42.7
ALL CLASSES	1093.6	145.0	1726.6	1077.1	733.0	570.6	914.6	121.0	1722.4	1153.0	814.9	661.9

Table 22a. Periodic mortality (stems/A) during 1926-87 by diameter class on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

Diameter Class	All Sites					Moist				
	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987
.5 - 2.5	648.4	15.9	586.8	292.4	160.8	270.9	39.4	236.5	142.9	78.8
2.6 - 4.5	122.1	19.1	40.1	62.3	47.7	44.3	54.2	14.8	24.6	14.8
4.6 - 6.5	36.9	16.5	1.3	9.5	7.0	0	39.4	4.9	0	4.9
6.6 - 8.5	16.5	7.6	1.9	1.3	1.3	4.9	9.9	4.9	0	0
8.6 - 10.5	11.4	5.1	2.5	1.3	.6	0	9.9	9.9	0	0
10.6 - 12.5	5.7	8.9	0	1.3	.6	4.9	24.6	0	4.9	0
12.6 - 14.5	0	.6	.6	1.3	.6	0	4.9	4.9	0	0
14.6 - 16.5	0	1.9	0	1.3	0	N	N	0	N	0
16.6 - 18.5	.6	.6	0	0	0	N	N	0	0	0
> 18.5	0	.6	0	.6	0	N	N	N	0	0
Saplings	770.5	35.0	626.8	354.7	208.5	315.3	93.6	251.2	167.5	93.6
Poles	64.8	29.2	5.7	12.1	8.9	4.9	59.1	19.7	0	4.9
Sawtimber	6.4	12.7	.6	4.5	1.3	4.9	29.6	4.9	4.9	0
ALL CLASSES	841.7	76.9	633.2	371.3	218.7	325.1	182.3	275.9	172.4	98.5

Table 22b. Periodic mortality (stems/A) during 1926-87 by diameter class on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

Diameter Class	Medium Moist					Dry				
	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987
.5 - 2.5	750.5	14.7	662.4	337.6	175.2	523.1	3.6	544.5	224.2	163.7
2.6 - 4.5	134.9	14.7	31.2	56.9	52.3	128.1	10.7	92.5	110.3	53.4
4.6 - 6.5	40.4	13.8	0	9.2	6.4	49.8	10.7	3.6	17.8	10.7
6.6 - 8.5	11.9	5.5	1.8	.9	1.8	42.7	14.2	0	3.6	0
8.6 - 10.5	8.3	3.7	1.8	.9	0	32.0	7.1	0	3.6	3.6
10.6 - 12.5	1.8	6.4	0	0	.9	21.4	7.1	0	3.6	0
12.6 - 14.5	0	0	0	1.8	.9	N	N	0	0	0
14.6 - 16.5	0	2.8	0	.9	0	N	N	N	3.6	N
16.6 - 18.5	.9	.9	0	0	0	N	N	N	N	0
> 18.5	0	.9	0	.9	0	N	N	N	N	N
Saplings	885.3	29.4	693.6	394.5	227.5	651.2	14.2	637.0	334.5	217.1
Poles	60.6	22.9	3.7	11.0	8.3	124.6	32.0	3.6	24.9	14.2
Sawtimber	2.8	11.0	0	3.7	1.8	21.4	7.1	0	7.1	0
ALL CLASSES	948.6	63.3	697.2	409.2	237.6	797.2	53.4	640.6	366.5	231.3

Table 23a. Stand basal area (ft<sup>2</sup>/A) during 1926-87 of burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	All Sites						Moist					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
Sugar maple	6.4	5.8	5.4	7.0	8.4	10.2	12.8	13.8	14.1	17.9	21.3	25.9
Red maple	4.0	2.9	4.4	5.9	7.1	8.7	5.5	4.7	6.8	7.3	4.8	5.7
Bitternut hickory	N	N	N	N	N	N	N	N	N	N	N	N
Mockernut hickory	.1	N	.2	.2	.1	.1	N	N	N	N	N	N
Pignut hickory	4.8	1.7	2.5	2.3	2.4	2.5	N	N	N	N	N	N
Shagbark hickory	.4	.1	.3	.4	.4	.4	N	N	N	N	N	N
Northern red oak	4.7	3.7	8.5	10.9	10.9	14.0	3.6	3.5	.2	1.0	1.1	1.2
Black oak	4.5	2.2	5.7	7.9	8.1	8.5	.5	N	.9	2.1	3.2	5.6
Scarlet oak	2.1	.7	2.1	2.4	2.5	3.0	3.5	3.9	1.0	1.3	1.6	2.2
White oak	7.5	5.1	10.3	11.7	11.9	13.5	4.8	6.2	9.0	10.7	12.2	13.7
Chestnut oak	8.1	4.4	10.8	12.1	9.9	11.7	4.7	5.3	7.5	8.7	9.6	10.8
Yellow birch	4.9	3.6	3.7	4.0	4.6	5.2	15.7	19.4	16.6	16.7	19.6	23.1
Black birch	13.2	11.9	16.0	19.1	19.1	21.3	N	N	N	N	N	N
American beech	.4	.4	.3	.4	.4	.5	N	N	N	N	N	N
White ash	3.8	2.9	1.8	1.2	1.2	1.1	13.6	14.2	4.7	.1	.1	.2
Black ash	.4	N	N	N	N	N	3.3	N	N	N	N	N
Tulip	1.7	1.9	4.9	6.2	9.6	12.8	1.8	1.3	2.4	.7	2.5	5.4
American elm	N	N	N	N	N	N	N	N	.1	.1	.1	N
Bigtooth aspen	1.5	N	.1	N	N	.1	N	N	N	N	N	N
Tupelo	.4	.5	N	N	N	.1	2.8	3.9	.2	.2	.3	.6
Butternut	.4	N	.3	.3	.3	.1	N	N	N	N	N	N
Black cherry	.1	N	.4	.2	.1	N	N	N	N	N	N	N
Sassafras	.3	N	.4	.4	.4	.5	N	N	.3	.7	1.3	2.2
White pine	N	N	.3	.7	1.3	1.9	N	N	N	N	N	N
MAJOR SPECIES	69.8	47.8	78.4	93.3	98.8	116.3	72.5	76.1	63.7	67.4	77.8	96.6
Chestnut	N	N	N	N	.3	.1	N	N	N	.2	1.1	N
Flowering dogwood	2.3	.2	2.5	1.9	1.8	.1	.2	N	.5	N	N	N
Blue-beech	1.8	N	.5	.3	.2	.2	1.4	N	1.1	.9	.5	.4
Hophornbeam	.9	N	.4	.3	N	.1	.6	N	N	N	N	N
Gray birch	.9	T	.1	N	N	N	N	N	N	.1	.2	.3
Redcedar	1.4	N	N	N	N	N	N	N	N	N	N	N
MINOR SPECIES	7.4	.2	3.5	2.5	2.3	.5	2.2	N	1.7	1.3	1.9	.7
ALL SPECIES	77.2	48.0	81.9	95.8	101.2	116.8	74.7	76.1	65.4	68.7	79.7	97.3

Table 23b. Stand basal area (ft<sup>2</sup>/A) during 1926-87 of burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	Medium Moist						Dry					
	1926	1934	1957	1967	1977	1987	1926	1934	1957	1967	1977	1987
Sugar maple	6.8	5.7	4.9	6.4	7.7	9.3	.3	.2	.7	1.2	1.7	2.3
Red maple	3.6	2.8	3.9	5.6	7.3	8.9	4.4	1.6	4.5	6.2	8.2	10.3
Bitternut hickory	N	N	N	N	N	N	N	N	.1	N	N	N
Mockernut hickory	.1	N	.3	.2	.2	.2	N	N	N	N	N	N
Pignut hickory	3.8	1.7	2.5	2.1	2.0	2.0	12.2	2.9	4.3	4.8	5.5	6.2
Shagbark hickory	.6	.2	.4	.5	.5	.6	.3	N	N	N	N	N
Northern red oak	3.9	4.0	9.6	11.9	11.4	14.5	8.8	2.5	10.4	14.6	16.1	21.1
Black oak	6.2	3.2	7.8	10.8	10.9	10.9	.8	N	.8	1.0	1.1	1.0
Scarlet oak	1.5	.3	2.0	2.0	2.0	2.6	3.3	N	3.6	4.5	4.8	5.4
White oak	8.0	6.0	12.0	13.7	13.9	16.5	7.5	.5	4.3	4.4	4.1	1.7
Chestnut oak	2.4	1.6	4.9	5.0	4.1	4.7	32.6	14.8	36.4	42.2	32.4	39.3
Yellow birch	3.7	1.6	2.3	2.7	2.9	3.2	1.8	N	.2	.2	.3	.3
Black birch	18.1	16.9	22.5	26.8	26.5	29.5	3.5	1.2	1.9	2.8	4.0	4.8
American beech	.5	.6	.4	.5	.6	.8	N	N	N	N	N	N
White ash	1.4	.4	.6	.5	.4	.2	6.0	4.3	4.6	4.8	5.1	5.4
Black ash	N	N	N	N	N	N	N	N	N	N	N	N
Tulip	2.1	2.6	6.6	8.9	13.4	17.5	N	N	N	N	N	N
American elm	N	N	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	1.1	N	.2	N	.1	.1	3.7	N	.1	N	N	N
Tupelo	N	N	N	N	N	N	N	N	N	N	N	N
Butternut	.4	N	.3	.4	.5	.2	.8	N	.2	N	N	N
Black cherry	.1	N	.5	.2	.1	N	N	N	.2	.3	.3	N
Sassafras	.4	N	.4	.3	.2	.2	.3	N	.2	.4	.4	.3
White pine	N	N	N	N	N	N	N	N	1.9	3.9	7.1	10.6
MAJOR SPECIES	64.9	47.6	82.1	98.5	104.6	121.8	86.3	28.0	74.3	91.6	91.2	108.9
Chestnut	N	N	N	N	.2	.1	N	N	N	N	N	N
Flowering dogwood	3.0	.3	3.3	2.5	2.2	.1	1.3	N	1.0	1.2	1.4	.2
Blue-beech	2.3	N	.4	.2	.1	.1	.2	N	.2	.2	.3	.5
Hophornbeam	1.2	N	.5	.2	N	N	.1	N	.2	.4	.2	.3
Gray birch	1.3	N	.1	N	N	N	N	N	N	N	N	N
Redcedar	1.9	N	N	N	N	N	.7	N	N	N	N	N
MINOR SPECIES	9.7	.3	4.3	3.0	2.5	.3	2.3	N	1.4	1.9	1.9	.9
ALL SPECIES	74.6	47.9	86.5	101.4	107.1	122.1	88.6	28.0	75.7	93.4	93.1	109.8

Table 24a. Periodic ingrowth (stems/A) during 1926-87 on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	All Sites					Moist				
	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	.6	104.3	11.4	3.2	3.8	4.9	59.1	19.7	N	N
Red maple	N	172.9	10.8	17.2	12.7	N	49.3	24.6	4.9	9.8
Bitternut hickory	N	1.9	N	N	N	N	N	N	N	N
Mockernut hickory	N	12.1	N	N	.6	N	N	N	N	N
Pignut hickory	N	92.2	N	1.9	1.3	N	N	N	N	N
Shagbark hickory	N	1.9	1.3	N	N	N	N	N	N	N
Northern red oak	N	111.9	3.2	N	5.1	N	34.5	4.9	N	N
Black oak	N	42.0	1.9	N	1.3	N	4.9	4.9	N	N
Scarlet oak	N	44.5	N	.6	.6	N	54.2	N	N	N
White oak	N	78.2	1.9	N	.6	N	19.7	4.9	N	4.9
Chestnut oak	N	145.0	1.9	1.9	4.4	N	69.0	4.9	N	N
Yellow birch	1.9	45.1	1.9	6.4	4.4	14.8	157.6	9.8	4.9	9.8
Black birch	.6	216.8	3.8	4.4	12.7	N	9.8	N	N	4.9
Beech	N	22.2	1.3	N	4.4	N	N	N	N	N
White ash	N	19.7	.6	N	N	N	4.9	N	N	N
Tulip	N	49.6	1.9	N	N	N	9.8	9.8	N	N
American elm	N	1.3	N	N	N	N	9.8	N	N	N
Bigtooth aspen	N	3.8	N	N	N	N	N	N	N	N
Tupelo	N	4.4	N	N	N	N	34.5	N	N	N
Butternut	N	3.2	N	N	N	N	N	N	N	N
Black cherry	N	12.7	.6	N	1.3	N	4.9	N	N	N
Sassafras	N	36.2	.6	2.5	4.4	N	39.4	4.9	N	4.9
White pine	N	1.9	N	N	N	N	N	N	N	N
MAJOR SPECIES	3.2	1223.8	43.2	38.1	57.8	19.7	561.6	88.7	9.8	34.5
Chestnut	N	2.5	2.5	7.0	3.2	N	9.8	4.9	N	N
Flowering dogwood	N	182.4	6.4	4.4	N	N	9.8	N	N	N
Blue-beech	N	73.7	3.8	1.9	5.1	N	73.9	4.9	N	N
Shadbush	N	.6	N	N	N	N	4.9	N	N	N
Hophornbeam	N	36.2	2.5	N	4.4	N	9.8	N	N	N
Gray birch	N	3.2	N	N	N	N	4.9	N	N	N
MINOR SPECIES	N	298.8	15.3	13.4	12.7	N	113.3	9.8	N	N
ALL SPECIES	3.2	1522.6	58.5	51.5	70.6	19.7	674.9	98.5	9.8	34.5



Table 24b. Periodic ingrowth (stems/A) during 1926-87 on burned portion of Turkey Hill tract. Fire in 1932; post-fire inventory in 1934. N indicates no stems present.

SPECIES	Medium Moist					Dry				
	1926 -1934	1934 1957	1957 -1967	1967 -1977	1977 -1987	1926 -1934	1934 -1957	1957 -1967	1967 -1977	1977 -1987
Sugar maple	N	122.9	12.8	4.6	5.5	N	64.1	N	N	N
Red maple	N	161.5	5.5	20.2	12.8	N	306.0	21.4	14.2	14.2
Bitternut hickory	N	.9	N	N	N	N	7.1	N	N	N
Mockernut hickory	N	16.5	N	N	.9	N	3.6	N	N	N
Pignut hickory	N	119.3	N	2.8	1.8	N	53.4	N	N	N
Shagbark hickory	N	2.8	1.8	N	N	N	N	N	N	N
Northern red oak	N	110.1	.9	N	6.4	N	174.4	10.7	N	3.6
Black oak	N	55.0	1.8	N	1.8	N	17.8	N	N	N
Scarlet oak	N	39.4	N	.9	.9	N	56.9	N	N	N
White oak	N	75.2	.9	N	N	N	131.7	3.6	N	N
Chestnut oak	N	68.8	N	2.8	6.4	N	494.7	7.1	N	N
Yellow birch	N	33.0	.9	7.3	2.8	N	10.7	N	3.6	7.1
Black birch	N	284.4	4.6	4.6	7.3	3.6	103.2	3.6	7.1	39.2
Beech	N	31.2	1.8	N	4.6	N	3.6	N	N	7.1
White ash	N	.22.9	N	N	N	N	17.8	3.6	N	N
Tulip	N	67.9	.9	N	N	N	7.1	N	N	N
American elm	N	N	N	N	N	N	N	N	N	N
Bigtooth aspen	N	4.6	N	N	N	N	3.6	N	N	N
Tupelo	N	N	N	N	N	N	N	N	N	N
Butternut	N	3.7	N	N	N	N	3.6	N	N	N
Black cherry	N	15.6	.9	N	1.8	N	7.1	N	N	N
Sassafras	N	35.8	N	3.7	5.5	N	35.6	N	N	N
White pine	N	N	N	N	N	N	10.7	N	N	N
MAJOR SPECIES	N	1271.6	33.0	46.8	58.7	3.6	1512.5	49.8	24.9	71.2
Chestnut	N	1.8	2.8	10.1	4.6	N	N	N	N	N
Flowering dogwood	N	236.7	7.3	5.5	N	N	96.1	7.1	3.6	N
Blue-beech	N	83.5	3.7	2.8	6.4	N	35.6	3.6	N	3.6
Shadbush	N	N	N	N	N	N	N	N	N	N
Hophornbeam	N	47.7	.9	N	5.5	N	10.7	10.7	N	3.6
Gray birch	N	3.7	N	N	N	N	N	N	N	N
MINOR SPECIES	N	373.4	14.7	18.4	16.5	N	142.4	21.4	3.6	7.1
ALL SPECIES	N	1645.0	47.7	65.1	75.2	3.6	1654.8	71.2	28.5	78.3

Table 25. 10- or 20-year transition probabilities (percentages) of species groups according to number of stems per plot. Medium moist site. 253 1/40th-acre plots.

1937	1927					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	77.9	4.8	17.6	3.6	3.6	74
Birch	9.1	85.7	3.9	7.1	10.9	53
Maple	10.4	7.1	76.5	10.7	3.6	55
Other	0	2.4	0	60.7	7.3	22
Minor	2.6	0	2.0	17.9	74.6	49
No. plots	77	42	51	28	55	253

1957	1937					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	50.0	3.8	5.4	4.6	4.1	45
Birch	17.6	73.6	10.9	4.6	2.0	60
Maple	18.9	13.2	70.9	18.2	14.3	71
Other	4.0	3.8	3.6	45.4	10.2	22
Minor	9.5	5.7	9.1	27.3	69.4	55
No. plots	74	53	55	22	49	253

1967	1957					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	15.6	1.7	0	0	3.6	10
Birch	31.1	80.0	11.3	4.6	14.6	79
Maple	33.3	8.3	84.5	18.2	16.4	93
Other	4.4	5.0	2.8	45.4	5.4	20
Minor	15.6	5.0	1.4	31.8	60.0	51
No. plots	45	60	71	22	55	253

1977	1967					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	20.0	1.3	0	0	3.9	5
Birch	30.0	68.4	23.7	15.0	19.6	92
Maple	20.0	13.9	65.6	10.0	17.6	85
Other	0	5.1	4.3	60.0	2.0	21
Minor	30.0	11.4	6.4	15.0	56.9	50
No. plots	10	79	93	20	51	253

1987	1977					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	100.0	0	2.4	0	4.0	9
Birch	0	89.1	20.0	23.8	22.0	115
Maple	0	6.5	72.9	0	22.0	79
Other	0	4.4	3.5	71.4	12.0	28
Minor	0	0	1.2	4.8	40.0	22
No. plots	5	92	85	21	50	253

Table 26. Observed and estimated 20-year transition probabilities (percentages) of species groups according to number of stems per plot. Medium moist site. 253 1/40th-acre plots.

1957	Observed 1937					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	50.0	3.8	5.4	4.6	4.1	45
Birch	17.6	73.6	10.9	4.6	2.0	60
Maple	18.9	13.2	70.9	18.2	14.3	71
Other	4.0	3.8	3.6	45.4	10.2	22
Minor	9.5	5.7	9.1	27.3	69.4	55
No. plots	74	53	55	22	49	253

20 yr	Estimated from 1927-37 transitions Begin					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	63.0	9.2	27.4	7.8	6.9	72
Birch	15.6	74.3	8.1	13.1	18.5	67
Maple	16.8	12.3	60.7	16.2	7.4	59
Other	0.4	3.5	0.2	38.3	10.1	16
Minor	4.2	0.7	3.5	24.5	57.1	39
No. plots	74	53	55	22	49	253

Table 27. 10- or 20-year transition probabilities (percentages) of species groups in the upper canopy according to number of stems per plot. Medium moist site. 253 1/40th-acre plots.

1937	1927						No. plots
	Oak	Birch	Maple	Other	Minor	Empty	
Oak	94.2	26.8	23.1	17.5	17.6	20.0	154
Birch	2.2	58.5	0	7.5	5.9	0	31
Maple	1.5	2.4	76.9	0	0	0	13
Other	.7	4.9	0	72.5	11.8	0	34
Minor	.7	2.4	0	0	64.7	0	13
Empty	.7	4.9	0	2.5	0	80.0	8
No. Plots	137	41	13	40	17	5	253

1957	1937						No. plots
	Oak	Birch	Maple	Other	Minor	Empty	
Oak	90.3	9.7	15.4	23.5	53.8	25.0	161
Birch	3.9	74.2	15.4	0	23.1	25.0	36
Maple	2.0	3.2	30.8	0	7.7	12.5	10
Other	0	3.2	15.4	76.5	7.7	0	30
Minor	.6	0	0	0	0	0	1
Empty	3.2	9.7	23.1	0	7.7	37.5	15
No. Plots	154	31	13	34	13	8	253

1967	1957						No. plots
	Oak	Birch	Maple	Other	Empty	plots	
Oak	80.1	5.6	10.0	10.0	0	136	
Birch	5.6	86.1	0	6.7	6.7	43	
Maple	3.7	2.8	90.0	3.3	6.7	18	
Other	2.5	0	0	76.7	6.7	28	
Empty	8.1	5.6	0	3.3	80.0	28	
No. Plots	161	36	10	30	15	253	

1977	1967						No. plots
	Oak	Birch	Maple	Other	Empty	plots	
Oak	89.7	9.3	11.1	3.6	0	129	
Birch	2.2	69.8	11.1	7.1	10.7	40	
Maple	2.9	4.6	61.1	0	3.6	18	
Other	.7	4.6	0	82.1	3.6	27	
Empty	4.4	11.6	16.7	7.1	82.1	39	
No. Plots	136	43	18	28	28	253	

1987	1977						No. plots
	Oak	Birch	Maple	Other	Empty	plots	
Oak	95.4	2.5	16.7	0	2.6	128	
Birch	1.6	65.0	27.8	3.7	12.8	39	
Maple	0	2.5	38.9	3.7	7.7	12	
Other	1.6	12.5	11.1	81.5	2.6	32	
Empty	1.6	17.5	5.6	11.1	74.4	42	
No. Plots	129	40	18	27	39	253	

Table 28. 10- or 20-year transition probabilities (percentages) of species groups according to stocking level per plot. Medium moist site. 253 1/40th-acre plots.

1937	1927					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	95.1	8.3	5.3	13.5	11.5	130
Birch	2.4	87.5	10.5	10.8	3.8	52
Maple	.8	2.1	84.2	0	3.8	19
Other	1.6	2.1	0	75.7	11.5	34
Minor	0	0	0	0	69.2	18
No. plots	123	48	19	37	26	253

1957	1937					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	91.5	19.2	21.0	23.5	38.9	148
Birch	2.3	76.9	5.3	11.8	11.1	50
Maple	3.1	1.9	68.4	2.9	11.1	21
Other	1.5	1.9	0	61.8	16.7	27
Minor	1.5	0	5.3	0	22.2	7
No. plots	130	52	19	34	18	253

1967	1957					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	78.4	4.0	0	7.4	14.3	121
Birch	6.1	92.0	4.8	7.4	0	58
Maple	10.8	2.0	95.2	3.7	28.6	40
Other	4.0	2.0	0	81.5	14.3	30
Minor	.7	0	0	0	42.9	4
No. plots	148	50	21	27	7	253

1977	1967					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	86.0	0	0	10.0	0	107
Birch	6.6	93.1	7.5	13.3	25.0	70
Maple	4.1	3.4	85.0	6.7	25.0	44
Other	3.3	3.4	7.5	70.0	0	30
Minor	0	0	0	0	50.0	2
No. plots	121	58	40	30	4	253

1987	1977					No. plots
	Oak	Birch	Maple	Other	Minor	
Oak	95.3	4.3	4.6	10.0	0	110
Birch	1.9	87.1	13.6	6.7	0	71
Maple	.9	4.3	77.3	3.3	0	39
Other	1.9	4.3	4.6	80.0	100.0	33
Minor	0	0	0	0	0	0
No. plots	107	70	44	30	2	253

Table 29. Distribution of plots among species groups during three inventories and as estimated by the transition probabilities of 1927-37. Medium moist site. 253 1/40th-acre plots.

Upper canopy					
Species group	1927	1957		1987	
	Observed	Expected	Observed	Expected	Observed
Oak	137	175.1	161	189.7	128
Birch	41	20.9	36	15.6	39
Maple	13	13.1	10	13.5	12
Other	40	24.4	30	16.1	32
Minor	17	8.4	0	5.8	0
Empty	5	11.0	15	12.2	42
Chi-square		23.823, d.f. = 5		149.693, d.f. = 5	

Stocking level					
Species group	1927	1957		1987	
	Observed	Expected	Observed	Expected	Observed
Oak	123	140.1	148	149.1	110
Birch	48	57.1	50	60.3	71
Maple	19	18.5	21	17.7	39
Other	37	28.2	27	22.0	33
Minor	26	8.6	7	2.8	0
Chi-square		2.009, d.f. = 4		45.996, d.f. = 4	

Table 31. Steady states (percentages) anticipated from the transition probabilities of species groups based on stems in the upper canopy or stocking level. Medium moist site. 253 1/40th-acre plots.

Upper canopy							
Interval	Oak	Birch	Maple	Other	Minor	Empty	Yrs to steady state
	1927-27	78.9	5.1	5.5	3.9	2.0	4.6
1937-57	62.1	19.9	4.1	5.6	0.4	7.9	300
1957-67	24.5	21.7	29.1	7.5	-	17.2	320
1967-77	29.5	19.0	7.4	12.5	-	31.6	300
1977-87	37.6	15.7	4.7	19.6	-	22.5	440

Stocking level						
Interval	Oak	Birch	Maple	Other	Minor	Yrs to steady state
	1927-27	64.1	23.3	6.4	6.3	-
1937-57	72.2	12.5	8.9	4.4	2.0	340
1957-67	9.6	39.6	44.2	6.5	0.1	330
1967-77	9.2	56.7	21.3	12.8	-	400
1977-87	55.9	23.5	8.5	12.2	-	360

Table 30. Distribution of plots among species groups during two inventories and as estimated by the transition probabilities of 1967-77. Medium moist site. 253 1/40th-acre plots.

Upper canopy			
Species group	1967	1987	
	Observed	Expected	Observed
Oak	136	122.4	128
Birch	43	38.8	39
Maple	18	17.9	12
Other	28	26.2	32
Empty	28	47.2	42
Chi-square		4.055, d.f. = 4	

Stocking level			
Species group	1967	1987	
	Observed	Expected	Observed
Oak	121	95.1	110
Birch	58	80.0	71
Maple	40	46.6	39
Other	30	30.2	33
Minor	4	1.0	0
Chi-square		5.867, d.f. = 4	

Table 32. Transition probabilities (percentages) for 1977-87 of species groups according to number of stems per plot from three antecedent states in 1927. Medium moist site. Number of 1/40th-acre plots indicated for each antecedent state.

1987	Oak in 1927					No. plots
	Oak	Birch	Maple	Other	Empty	
Oak	96.8	0	14.3	0	0	92
Birch	0	87.5	42.9	0	16.0	14
Maple	0	0	28.6	0	8.0	4
Other	1.1	0	14.3	100.0	0	5
Empty	2.1	12.5	0	0	76.0	22
No. plots	94	8	7	3	25	137

1987	Birch in 1927					No. plots
	Oak	Birch	Maple	Other	Empty	
Oak	90.9	0	50.0	0	0	11
Birch	9.1	69.6	0	0	50.0	18
Maple	0	0	50.0	0	0	1
Other	0	13.0	0	100.0	0	6
Empty	0	17.4	0	0	50.0	5
No. plots	11	23	2	3	2	41

1987	Other in 1927					No. plots
	Oak	Birch	Maple	Other	Empty	
Oak	90.9	0	0	0	16.7	11
Birch	9.1	20.0	0	5.9	0	3
Maple	0	0	100.0	5.9	16.7	3
Other	0	40.0	0	70.6	0	14
Empty	0	40.0	0	17.6	66.7	9
No. plots	11	5	1	17	6	40



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