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An ecological study of the Klein woods, Jennings County, Indiana

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The *Butler University Botanical Studies* journal was published by the Botany Department of Butler University, Indianapolis, Indiana, from 1929 to 1964. The scientific journal featured original papers primarily on plant ecology, taxonomy, and microbiology. The papers contain valuable historical studies, especially floristic surveys that document Indiana's vegetation in past decades. Authors were Butler faculty, current and former master's degree students and undergraduates, and other Indiana botanists. The journal was started by Stanley Cain, noted conservation biologist, and edited through most of its years of production by Ray C. Friesner, Butler's first botanist and founder of the department in 1919. The journal was distributed to learned societies and libraries through exchange.

During the years of the journal's publication, the Butler University Botany Department had an active program of research and student training. 201 bachelor's degrees and 75 master's degrees in Botany were conferred during this period. Thirty-five of these graduates went on to earn doctorates at other institutions.

The Botany Department attracted many notable faculty members and students. Distinguished faculty, in addition to Cain and Friesner , included John E. Potzger, a forest ecologist and palynologist, Willard Nelson Clute, co-founder of the American Fern Society, Marion T. Hall, former director of the Morton Arboretum, C. Mervin Palmer, Rex Webster, and John Pelton. Some of the former undergraduate and master's students who made active contributions to the fields of botany and ecology include Dwight. W. Billings, Fay Kenoyer Daily, William A. Daily, Rexford Daudenmire, Francis Hueber, Frank McCormick, Scott McCoy, Robert Petty, Potzger, Helene Starcs, and Theodore Sperry. Cain, Daubenmire, Potzger, and Billings served as Presidents of the Ecological Society of America.

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AN ECOLOGICAL STUDY OF THE KLEIN WOODS, JENNINGS COUNTY, INDIANA

By CARL O. KELLER

The primeval forest of Indiana was without doubt representative of some of the most magnificent sections of the great eastern deciduous region. In a previous paper (9) we described briefly the fate of our hardwoods; and pointed out that only small tracts of comparatively undisturbed stands remain for observation. Since reports on the early forests are rather vague, and based on superficial observation rather than on quantitative data, it is somewhat difficult to gain from them a true picture of the phytosociology of these forests prior to time of settlement. Qualitative and quantitative studies of the remaining small stands referred to above, however, enable us to set up, or establish a fairly accurate norm with which to compare areas which have been disturbed, and see to what extent this disturbance has progressed. For detailed studies of a number of such stands, the reader is referred to the following literature references (1, 2, 5, 6, 7, 8, 9, 13, 14, 15, 16, 17, 18, 19).

As these remnants of the primeval forest give us a concept of what the sociology of the original forests comprised, they also clear up some existing misconceptions concerning forest types found in Indiana at the present time. Zon (21) has placed the greater part of Indiana woodlands into the oak-hickory type. The Committee on Forest Types of the Society of American Foresters (20) places the eastern "flats" area into the beech type, with beech definitely predominating. It might be reasonable to expect that an area so small as the state of Indiana, with so little variation in surface and elevation, would support a somewhat homogeneous type of vegetation, but investigations on record show that this is not the case. On the bases of these investigations Deam (4) has charted the various botanical areas of the state. McCoy (14) has shown that even on the Illinoian till plain great variation in forest composition prevails. The survey of the Klein woods not only shows the effect of various kinds of disturbance on forests in the areas compared in the present study, but also shows that in the eastern "flats" the sociology is not uniform in all stands.

The survey for this study was made in April 1943. The data have been arranged in such a way (table II) that it can readily be compared with the sixteen eastern "flats" stands studied by McCoy (14), and also with two sectors of the Guthrie Memorial Tract study made by the same writer (13).

LOCATION OF THE AREAS CONSIDERED

The eighteen forest stands referred to in this study are all located within, or adjacent to, that section of the Illinoian till plain known as the eastern "flats." This includes all of Ripley County, practically all of Jennings County, and the edges of the counties adjoining these two.

The Klein woods lies near the northwest corner of Jennings County, in Geneva Township, Sec. 8, T. 7N., R. 8E. Of the other stands considered, 2-A through 2-F, and the two sectors of the Guthrie Memorial Tract are also located in Jennings County. 2-G through 2-J are in the western part of Jefferson County. 2-K is in the southeastern part of Jackson County. 2-L through 2-O are in Ripley County, and 2-P is in the southeastern part of Franklin County. All stands lie within the boundary of the eastern "flats." area except 2-H, 2-I, 2-J, and 2-K.

GEOLOGY AND PHYSIOGRAPHY OF JENNINGS COUNTY

The physiography of Jennings County is that of the till plains section of the Central Lowland province of the United States (11). Locally it is part of the Muscatatuck Regional Slope, a structural upland plain developed on Silurian and Devonian formations. The elevation ranges from 535-767 feet, with an average of 710 feet. The land slopes generally to the west and southwest at a rate of 18 feet to the mile. This is somewhat less than the slope of the underlying strata of bedrock. The bedrock consists mainly of limestone which is overlain by a stratum of dark oil shale in the western part of the county. The pre-glacial relief has been somewhat evened by a thin layer of Illinoian drift ranging in depth up to 100 feet. On the divides this old drift surface is almost featureless.

According to the 1940 soil survey report (10), the normally developed soils of Jennings County are leached and belong to the gray-brown podzolic soils group (12). This kind of soil is generally found under forest covers in a humid, temperate climate. On the

flat, poorly drained forest land, which is characteristic of most of the county, soil development has been extreme, and planosols, or "claypan" soils have been formed. These planosols owe their character primarily to the influences of relief and time. Climate and native vegetation are negligible factors in their formation.

The soil type found to be most extensive in Jennings County is Clermont silt loam. This occurs on the flattest central parts of the main divides, and is separated from the open drainage ways by almost continuous strips of Avonburg silt loam. The soil is of a light gray color, and has a definite acid reaction. Due to its flat relief and its impervious lower horizons, drainage is very poor. Because of this, it is generally unsuitable for the growth of crops. By extensive treatment it could be improved, but in many cases the cost of treatment would exceed the market value of the unimproved land (10).

The soil of the Klein woods appears to be somewhat more sandy than that in other parts of the county, showing streaks of yellowish, sandy clay.

CLIMATE AND RAINFALL

The climate of this area is continental in nature, with hot summers and moderately cold winters. The rainfall is fairly evenly distributed throughout the year. Occasional dry periods occur in late summer and autumn. The average frost-free season runs from April 26 to October 14, a period of 171 days. Records show, however, that frost has come as early as September 16, and as late as May 26. The following data, taken from the records of the U. S. Weather Bureau station at Butlerville, give a summary of the temperature and precipitation in Jennings County over a period of several years.

TEMPERATURE

(Degrees Fahrenheit)

	Mean	Maximum	Minimum
Winter	32.7°	73°	-26°
Spring	53.2°	98°	2°
Summer	74.1°	109°	35°
Fall	57.1°	103°	1°

PRECIPITATION

	Mean	Total for Driest Year	Total for Wettest Year	Snow Av. Depth
Winter	11.30	4.83	13.54	19.6
Spring	13.68	5.13	15.69	4.8
Summer	12.18	11.68	13.38	0.
Fall	10.31	6.11	18.75	1.1

Figures represent inches of precipitation.

AGRICULTURAL HISTORY

The decline of the forests in Jennings County began during the early days of settlement. Naturally, since the settlers had to get their living from the soil, the clearing of the land was their first important task. Much of the timber cut was used for building purposes, but since the need of tillable acreage was greater than the market for timber, much, also, was wasted. Lumbering soon became an important industry in this area, and continued to be until a few years ago, when the supply of good timber became almost depleted.

Commercial agriculture also developed rapidly and reached its peak between 1879 and 1919. Since 1919 the production of corn, wheat, and oats decreased rapidly. In 1934 the production of corn amounted to about 66% of that reported for 1919, and wheat had dropped to 50%. There has been an increase in the production of soybeans and vegetables, but this increase does not begin to compare with the decrease in acreage of cereal crops.

Assessors' reports for 1926-33 classify 25% of this area "not in farms." Nearly 30 per cent is rough pasture, timber, and waste land, and 10 per cent is idle crop land. Sixty-five per cent of Jennings County has little agricultural use except as pasture land of limited value. Only 25% is actually in harvested crops.

According to the Soil Survey of 1940 (10), about 16% of the county was then woodland. Nearly all of the merchantable timber, which originally was very abundant, had been cut. A few of the wooded areas are classified as forests by the state.

Up to now, little has been done to reforest lands that have been cleared and later abandoned for agricultural use. It is encouraging to note, however, that interest in reforestation of such areas in Indiana is growing, and that definite steps in this direction are being taken.

METHODS

This study is based on 50 100-square-meter quadrats, run in two parallel sectors, 10 meters apart. A skip of 10 meters was left between each quadrat. The laying out was done with a line looped at 10-meter intervals, as described in our previous studies (9, 19).

Wooden calipers were used to take the DBH. measurements. All stems over one inch in diameter were measured and recorded. All stems measuring less than one inch DBH. were also counted if they

were one meter or more in height. Although these were not figured into the basal area percentages, they were included to show what is taking place in the dynamics of reproduction. In table I the results of the survey are presented as representative of a stand in order to give an over-all picture of the sociology of the woods. In table II the findings are presented in units of 20 quadrats each in order to afford a more simple comparison with the "flats" areas studied by McCoy (14). Table II also includes two sectors of McCoy's survey of the Guthrie Memorial Tract (13) which was also referred to by way of comparison.

A comparison of frequency index and density of leading species found in the different areas was also made. These are shown in tables III, IV, and V. A summary description of all areas considered is presented in table VI.

The figures in columns 2, 3, and 8 of table VI represent the tree species listed with corresponding numbers at the head of the table. The basal area figures in column 4 are estimates, arrived at by taking an average DBH. figure for all the trees in each size class, rather than determining the basal area of all trees involved. Although this method allows for a certain percentage of error, it is not likely that it would make any change in the relative status of any sector, since estimates for all the sector were made in the same way.

OBSERVATIONS

In the Klein woods survey, there were 30 different woody species found. Of these, 14 are tall trees, 6 small trees, 3 shrubs, and 7 lianas. The dominant tall tree species, in decreasing order of importance, as shown by basal area percentages are: *Quercus palustris,* 27.05%; *Q. alba,* 21.69%; *Fagus grandifolia,* 21.61%; and *Acer rubrum,* 6.24%. On the basis of frequency, the following order would prevail: *Fagus grandifolia,* 98%; *Acer rubrum,* 76%; *Nyssa sylvatica,* 74%; *Liquidambar styraciflua,* 70%; and *Ulmus thomasii,* 56%. These are the only species in the large tree class showing a frequency of more than 38%. The higher frequencies found among the other classes were: *Smilax rotundifolia,* 80%; *Sassafras variifolium,* 54%; *Rhus toxicodendron,* 54%; and *Prunus serotina,* 48% (table I).

Among the young trees below one inch DBH., *Fagus grandifolia* showed the highest abundance, being followed by *Fraxinus americana* and *Acer saccharum* (tables IV and VI).

In six of the areas presented in McCoy's study of 1939 (14), *Fagus* alone represented 50%, or more, of the total basal area. In three other areas it showed the highest percentage, and ran second high in three areas (table VI). In the Guthrie Memorial Tract (13) *Fagus* was second high in the two sectors presented (table VI). Other trees with high basal area percentages in the "flats" sectors are: *Quercus palustris, Acer rubrum, Liquidambar styraciflua,* and *Quercus alba.*

The highest frequencies shown in McCoy's "flats" studies are as follows: *Fagus grandifolia,* 71.9%; *Liquidambar styraciflua,* 55.6%; *Nyssa sylvatica,* 46.3%; *Acer rubrum,* 43.8%; *Ulmus thomasii,* 36.2%; *Quercus alba,* 33.1%; and *Acer saccharum,* 30.6%.

In the Guthrie Tract as a whole the frequencies run as follows: *Acer rubrum,* 90%; *Carya ovata,* 83%; *Liquidambar styraciflua,* 74%; *Sassafras variifolium,* 70%; *Fagus grandifolia,* 66%; *Nyssa sylvatica,* 65%; *Ulmus americana,* 56%; *Carpinus caroliniana,* 45%; *Quercus palustris,* 39%; and *Fraxinus lanceolata,* 35%.

In the 50 quadrats of the Klein woods survey there were 439 stems above one inch DBH. Of these, 135 were *Fagus grandifolia,* 89 *Nyssa sylvatica,* and 59 *Acer rubrum.* This is an average of about 172 for each 20 quadrats. The other areas range from 71 to 586 per 20 quadrats. In the Guthrie Tract each sector had from 511 to 518 stems in this class, but there were no stems above 25 inches DBH.

In the count of stems below one inch DBH., *Fagus grandifolia* leads in the Klein woods with a total of 500. *Fraxinus americana* is second, with 277, and *Acer rubrum* is represented by 224 stems. In all, 1837 small stems were counted in the 50 quadrats, making an average of 612 for each 20 quadrats. In the Guthrie Tract the number ran from 498 to 679. In the other sectors a great deal of variation appeared, the lowest being 4 stems, and the highest 1263.

From the data assembled, no basis can be found for classifying the Klein woods, or the eastern "flats" forests as a whole, as a beech-maple forest as listed (type 57) by the American Society of Foresters (20). Viewing this area as a unit, we find various stages of transition between the flood-plain type of forest and the mature mixed-mesophytic forest which is quite common in this part of Indiana.

DISCUSSION

In comparing the Klein woods with other areas in the eastern lobe of the "flats," it is quite apparent that it comes nearer than any other to being a typical remnant of the original forest in this part of the state. Only five other stands have a comparable basal area coverage. Two of these slightly exceed that of the Klein woods, but due to pasturing and cutting, other factors do not compare so well (table VI). Only seven other areas have a comparable number of stems below one inch DBH. In some sectors this number runs very low, indicating that reproduction is being greatly reduced by pasturing and other disturbances. The average number of stems above one inch DBH. per sector in the Klein woods is about 172. In the Guthrie Tract the stems in this class number about 500 per sector. In six of the other sectors compared they also ran considerably over 200 stems, indicating a lack of maturity, or the result of some disturbance in the past.

The number of very large trees found also tells a significant story. In the 50 quadrats of the Klein woods there were 22 trees with DBH. measurements above 25 inches. This is an average of 8.8 per sector. In the Guthrie Tract there were no 25-inch trees. In the sixteen other sectors there were 43 such large trees found, making an average of 2.69 per sector. Five of these sectors, also, had no stems 25 inches or more in diameter.

On the basis of frequency, we should classify the Klein woods as a Fagus-Acer rubrum-Nyssa-Liquidambar-Fraxinus americana association. Considerable modification in drainage and soil conditions would have to take place before the true Acer-Fagus climax could be reached. The Guthrie Tract would fall into the Acer rubrum-Fagus-Carya ovata-Quercus palustris type of forest, with a number of other species showing a relatively high frequency, but since a number of abnormalities occur in the various factors involved in standards of comparison, it becomes obvious that this is not virgin forest, but second growth timber in a fairly mature stage of secondary succession. Factors indicating this are, the high frequency of Sassafras (70%), the greater number of species with high frequencies, and the greater number of stems above one inch DBH. The other areas compared show considerable variation, as may be seen from the frequency column in table VI, but *Acer rubrum* or

Acer saccharum and *Fagus grandifolia* are very prominent in most of them. In three of the stands, Fagus was the only genus with a frequency of more than 65%.

In most of these areas a direct correlation can be drawn between the soil conditions and the dominants growing there. Although the structure of the soil is largely uniform throughout, there are differences in drainage conditions. The high abundance of *Acer rubrum* in most of the stands and the scarcity or complete absence of *A. saccharum* shows that in most places the drainage is poor. *Acer saccharum* was prominent in only three areas, and these showed evidences of improved drainage.

Cain (3) points out that density, usually estimated under the name of abundance, should be distinguished clearly from dominance, the area or space covered by the plants. No attempt was made in this study to estimate the crown coverage of the various species, but a study of basal areas yielded some interesting figures. The oaks in the Klein woods cover more basal area than any other species. *Quercus palustris* and *Q. alba* control almost 50% of the total. In the Guthrie Tract, *Acer rubrum,* and *Fagus grandifalia* have the highest basal areas. In the other sectors, Fagus runs highest in most cases, being followed by *Liquidambar,* Acer, and Quercus. The Acer referred to is *A. rubrum* in most stands, but in the drier sites, *A. saccharum* takes its place.

In the "flats area we get a kaleidoscopic view of vegetation in various stages of succession, and, as these surveys and the agricultural history of Jennings County show, these stages represent various phases in Nature's fight to restore what man has, through ignorance and greed, destroyed. Most of the land in this region has, at some time or other, been stripped of its natural vegetation in an attempt to turn it into something for which it was never adapted. The result has been a struggling existence for many of its inhabitants, and a wasted opportunity to produce for coming generations that material, the shortage of which is becoming more and more critical, lumber.

SUMMARY

1. This study is the result of a survey of the Klein woods, located in Jennings County, Indiana, and a comparison of the findings with those from 18 other sectors previously surveyed in this general area. All sectors are located within the so-called "flats" region of

the Illinois Till Plain. The study is based on frequency, abundance, and basal area data derived from fifty 100-square-meter quadrats in the Klein woods, and twenty 100-square-meter quadrats in each of the other forests.

2. The findings show that the forests studied are not merely parts of a homogeneous association, but they represent various transitional stages.

3. In the Klein woods survey, 30 different woody species were found. Of these, 14 are tall trees, 6 small trees, 3 shrubs, and 7 lianas.

4. *Fagus grandifolia, Nyssa sylvatica,* and *Acer rubrum* make up more than 50% of all stems above one inch DBH. in the Klein woods. *Quercus palustris* and *Q. alba* constitute almost 50% of the basal area. *Fagus grandifolia* is, with few exceptions, very prominent in the other areas considered, but a marked degree of difference was found in the general sociology of the various areas.

5. The dominant tall tree species, from the standpoint of frequency, are: *Fagus grandifolia,* 98%; *Acer rubrum,* 76%; *Nyssa sylvatica,* 74%; *Liquidambar styraciflua,* 70%; *Fraxinus americana,* 70%; and *Ulmus thomasii,* 54%. Considering the basal area percentages, the following order prevails: *Quercus palustris,* 27.05%; *Q. alba,* 21.69%; *Fagus grandifolia,* 21.61%; *Liquidambar styraciflua,* 9.5%; *Nyssa sylvatica,* 6.58%; and *Acer rubrum,* 6.24%.

6. In the count of stems below one inch DBH., *Fagus grandifolia* leads the large tree class with a total of 500. *Fraxinus america* is represented by 277 stems, and *Acer rubrum* by 224. Beech and maple are not consistently prominent among the small stems of the other areas with which this woods was compared.

7. Considering the existing sociology of the forests of the "flats" region, no basis can be found for classifying the area as a whole, or any part of it, as beech-maple forest, as listed (type 57) by the Society of American Foresters. Each represents a transition type of the mixed-mesophytic forest in various stages of transition from the near flood-plain type of forest to that approaching climax.

8. The study also shows the result of disturbance in the various stands, and points out the advisability of an intensive reforestation program for the "flats" area.

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LITERATURE CITED

1. CAIN, STANLEY A. Studies on virgin hardwood forest, I. Density and frequency of the woody plants of Donaldson's woods, Lawrence County, Indiana. Indiana Acad. Sci. Proc. 41:105-122. 1932.
2. ————. Studies on virgin hardwood forest: II. A comparison of quadrat sizes in a quantitative phytosociological study of Nash's woods, Posey County, Indiana. Amer. Midl. Nat. 15:529-566. 1934.
3. ————. The climax and its complexities. Amer. Midl. Nat. 21:146-181. 1939.
4. DEAM, CHARLES C. Flora of Indiana. Indiana Dept. Conservation. 1940.
5. ESTEN, M. M. A statistical study of a beech-maple association at Turkey Run State Park, Parke County, Indiana. Butler Univ. Bot. Stud. 2:183-201. 1932.
6. FRIESNER, RAY C. Indiana as a critical botanical area. Indiana Acad. Sci. Proc. 46:28-45. 1937.
7. ———— and CHARLES M. EK. Correlation of microclimatic factors with species distribution in Shenk's woods, Howard County, Indiana. Butler Univ. Bot. Stud. 6:87-101. 1944.
8. ————. and J. E. POTZGER. Contrasts in certain physical factors in Fagus-Acer and Quercus-Carya communities in Brown and Bartholomew Counties, Indiana. Butler Univ. Bot. Stud. 4:1-12. 1937.
9. KELLER, CARL O. A quadrat study of Meltzer woods, Shelby County, Indiana. Butler Univ. Bot. Stud. 7:140-154. 1945.
10. KUNKEL, D. R., ET AL. Soil survey, Jennings County, Indiana. U. S. Dept. Agr. Bureau of Plant Industry. 1940.
11. MALOTT, CLYDE A. The physiography of Indiana. Indiana Dept. Conservation. Pub. 21:59-256. 1922.
12. MARBUT, C. F. Soils of the United States. U. S. Dept. Agr. Atlas of American Agriculture, pt. III. 1935.
13. MCCOY, SCOTT. An ecological study of the Guthrie Memorial Tract, a typical Illinoian till plain forest, Jennings County, Indiana. (Ms.) 1937.
14. ————. A phytosociological study of the woody plants constituting twenty-five type forests of the Illinoian till plain in Indiana. Indiana Aead. Sci. Proc. 48:50-66. 1939.
15. POTZGER, J. E. Topography and forest types in a central Indiana region. Amer. Midl. Nat. 16:212-229. 1935.

16. ———— and RAY C. FRIESNER. An ecological survey of Berkey Woods; A remnant of forest primeval in Kosciusko County, Indiana. Butler Univ. Bot. Stud. 6:10-16. 1943.

17. ————. Some comparisons between virgin forest and adjacent areas of secondary succession. Butler Univ. Bot. Stud. 3:85-98. 1934.

18. ————. What is climax in central Indiana? A five-mile quadrat study. Butler Univ. Bot. Stud. 4:181-195. 1940.

19. ———— and CARL O. KELLER. Phytosociology of Cox woods: A remnant of forest primeval in Orange County, Indiana. Butler Univ. Bot. Stud. 6:10-16. 1943.

20. SOCIETY OF AMERICAN FORESTERS. Forest cover types of the eastern U. S. Report of committee on forest types. Jour. Forest. 30:451-498. 1932.

21. ZON, RAPHAEL. Atlas of American Agriculture. U. S. Dept. Agric. 1924.

TABLE I

Size-classes, basal area percentages, and frequency index of various species in 50 quadrats of the Klein woods.

Species	Below 1″	1″	2″	3-5″	6-10″	11-15″	16-20″	21-25″	26-30″	31-35″	36-40″	41-45″	Total Stems above 1″	Basal Area in sq. ft.	Basal Area Percentage	quency Index
Acer rubrum	224	29	3	8	12	4	2		1				59	15.55	6.24	76
Asimina triloba	2															2
Carpinus caroliniana	2	2		1									3	.10	.04	8
Carya laeiniosa	12															16
C. ovata	19			3	1				1				5	3.83	1.44	30
Celastrus scandens	3															2
Cornus florida	37	5		1									6	.08	.03	22
Fagus grandifolia	500	68	22	3	3	18	16	5					135	57.37	21.61	98
Fraxinus americana	227	2				1							3	.93	.35	70
F. biltmoreana	1															2
Lindera benzoin	63	1											1	.005	.001	24
Liquidambar styraciflua	51	3		1	17	12	3	1					37	25.23	9.50	70
Liriodendron tulipifera	23	2	2					1					5	2.69	1.01	30
Morus rubra	3															6
Nyssa sylvatica	78	20	19	33	14		1		2				89	17.46	6.58	74
Ostrya virginiana	2															4
Prunus serotina	46	9	1										10	.07	.03	48
Quercus alba	6	1			2	4	5	4	2		2	1	21	57.58	21.69	38
Q. borealis var. maxima	1					1	3	1					5	8.43	3.18	8

TABLE I—(Continued)

Species	Below 1"	1"	2"	3-5"	6-10"	11-15"	16-20"	21-25"	26-30"	31-35"	36-40"	41-45"	Total Stems above 1"	Basal Area in sq. ft.	Basal Area Percentage	quency Index
Q. palustris	1					4	5	5	7	2			23	71.80	27.05	38
Q. prinus	9	1				1					1		3	.93	.35	14
Rhus toxieodendron	388															54
Ribes spp.	24															4
Rubus occidentalis	38															6
Sambucus canadensis	18															16
Smilax hispida	1															2
Smilax rotundifolia	569															80
Sassafras albidum	54	4			1	1	1						7	1.39	.52	54
Ulmus thomasii	145	14		8	5	1							28	1.01	.38	56
Vitis spp.	7															8

TABLE II

Size-classes of leading tree species in two sectors of the Klein woods and two sectors of the Guthrie Memorial Tract arranged in units of 20 quadrats each for comparison with McCoy's Illinois Till Plain studies.

Species	Sector A—Klein						Sector C—Klein						Sector B—Guthrie					Sector D—Guthrie				
	Below 1"	1-5"	6-10"	11-15"	16-25"	Over 25"	Below 1"	1-5"	6-10"	11-15"	16-25"	Over 25"	Below 1"	1-5"	6-10"	11-15"	16-25"	Below 1"	1-5"	6-10"	11-15"	16-25"
Acer rubrum	26	9	6	2		1	149	15	5	2	2		58	97	2	3		69	112	7	1	
Carya laciniosa	8						2															
C. ovata	11						8	3	1		1		31	15	1	1		15	24			
Fagus grandifolia	131	43	1	7	6		214	44		4	6		11	40	7	1		6	15	2	2	
Fraxinus americana	90						113	1														
F. lanceolata														5				2	5			
Liquidambar styraciflua	20	1	4	4	2		13	2	10	6			3	63	11	2		14	35	6	2	
Liriodendron tulipifera	5	3					8				1		25	60	3	1	1	15	30		1	
Nyssa sylvatica	38	43	5			1	38	26	7		1	1	12	20	1			19	17	2	1	
Quercus alba	4	1	1	2	7	2	2		1	2	2	3				1	2		4			1
Q. bicolor													2	1	1							
Q. borealis var. maxima	1			1	4													1				
Q. palustris	1			2	4	2				2	4	5	2	34	1			2	19			
Q. Prinus	5	1				1	3											10	3			
Ulmus americana													5	11	2			14	21	4		
Ulmus thomasii	29	1					76	15	1					3	1			1	12	2	1	

TABLE III

Frequency index of leading large tree species in the Klein woods compared with other areas in the eastern "flats."

Species	Klein Woods	2-A	2-B	2-C	2-D	2-E	2-F	2-G	2-H	2-I	2-J	2-K	2-L	2-M	2-N	2-O	2-P	Guthrie Memorial
Acer rubrum	76	95		15		65	100	40	65	40	45	85	35	50	15	50		90
A. saccharum			95		90	65	10	40			95						95	5
Carya laciniosa	16	20	10		5			5	15	25		10						
C. ovata	30	35	20	20	25	95	85	90	25	15	50	35	10	25	40	70	25	83
Fagus grandifolia	98		95	90	80	95	65	95	95		70	40	60	95	95	100	75	66
Fraxinus americana	70		10			35		10							20	80	65	1
F. biltmoreana	2		60	5	25	5		15	25		65							
F. lanceolata			75		30	85	35				35		5					35
Liquidambar styraciflua	70	90	40	45	30	60	95	100	65	100		85	5	30	60	80	5	74
Liriodendron tulipifera	30		25		20	30	90	60	30		5			5	25	15	30	66
Nyssa sylvatica	74	65	10	5	10	40	95	40	70	100	20	70	20	30	40	55	75	65
Quercus alba	38	20	5			80	15	45	55	65	65	55	25	20	10	35	35	25
Q. borealis var. maxima	8				5	55	20	10	35	15	15	55	10	10	5	25	20	12
Q. palustris	38	90					50	5	15	35		50	40	20				39
Ulmus americana			25				65	5			10				10	70	10	56
U. thomasii	56	100		20	45	60	45	70	70	25		30	10	20	15			29

TABLE IV

Density of stems below 1 inch DHB of leading large tree species in twenty-one 20-quadrat sectors of the eastern lobe of the "flats" area.

Species	1-A	1-C	2-A	2-B	2-C	2-D	2-E	2-F	2-G	2-H	2-I	2-J	2-K	2-L	2-M	2-N	2-O	2-P	3-B	3-D
Acer rubrum	26	149	202				2	91	19	19	1	7	284		6	1	16		58	69
A. saccharum				584		96	31		30			121						227		
Carya laciniosa	8	2	6	3					1	4			10							
C. ovata	11	8	16	5		14	113	24	76	8		10	11	2		36	43	4	31	15
Fagus grandifolia	131	214		153		77	73	6	305	163		27			12	37	70	22	11	13
Fraxinus americana	90	113		1			15		2							6	38	19		
F. biltmoreana	1			50	1	17	1		3	6		16								
F. lanceolata				35		15	95	3				12		1						2
Liquidambar styraciflua	20	13	16	72	5	9	4	32	421	12	9		115			26	61		3	14
Liriodendron tulipifera	5	8		18			17	33	10	8						1			25	15
Nyssa sylvatica	38	38	29	1			13	45	7	35	34	4	77			8	36	56	12	19
Quercus alba	4	2		1			48		14	17		9	30				2			
Q. borealis var. maxima	1						20	2	2	8		1	16				3			1
Q. palustris	1		9					7		1			14						2	2
Ulmus americana				9				19									39		5	9
U. thomasii	29	76	210		5	3	18	5	35	12	5		2			3				1

TABLE V

Density of stems 1 inch DBH and over of the leading large tree species in twenty-one 20-quadrat sectors of the eastern lobe of the "flats area.

Species	1-A	1-C	2-A	2-B	2-C	2-D	2-E	2-F	2-G	2-H	2-I	2-J	2-K	2-L	2-M	2-N	2-O	2-P	3-B	3-D
Acer rubrum	18	24	132		3		22	117	9	43	13	5	11	11	22	6	12		102	120
A. saccharinum				64		64	10	2	1			106						85		
Carya glabra							1				3	37						8		
C. laciniosa						1					7		2							
C. ovata		5	7	3	8		31	19	41		3	13	2	2	9	10	8	2	17	24
Fagus grandifolia	57	54		29	53	32	36	18	65	41		41	13	24	58	37	42	23	48	19
Fraxinus americana		1		2			1									2	10	9		
F. biltmoreana				4		22				2		4								
F. lanceolata				7		14		7											5	5
Liquidambar styraciflua	11	18	119	5	14	4	16	109	134	15	240		19	1	8	22	15	1	76	43
Liriodendron tulipifera	3	1		16		5	2	65	28	2		2			2	8	3	11	65	31
Nyssa sylvatica	49	35	66	1	1	2	14	36	3	21	222	4	13	5	7	8	17	36	21	20
Quercus alba	13	8	7				3	3	11	8	42	32	44	14	4	3	7	17	3	5
Q. borealis var. maxima	5					1		3	1	3	4	4	12	2	3	1	6	5		
Q. palustris	8	11	116					36	1	2	7		18	10	8				35	19
Ulmus americana				1				17	1			3				3	26	2	13	25
U. thomasii	1	16	109		2	12	1	11	28	10	4		6	2	8	1			4	15

TABLE VI

Summary comparison of all stands.

1—Fagus grandifolia 4—Fraxinus americana 7—Carya ovata 10—Quercus palustris 13—Carya glabra
2—Acer rubrum 5—Fraxinus lanceolata 8—Nyssa sylvatica 11—Ulmus thomasii 14—Ulmus americana
3—Acer saccharum 6—Liquidambar styraciflua 9—Quercus alba 12—Liriodendron tulipifera

Numbers of species above correspond with those in columns 2, 3, and 8 below.

Sector	Leading trees below 1" dbh.	Leading trees 1" or over (rated on basal area)	Est. basal area of all stems above 1" dbh. (sq. ft.)	Total Stems Below 1" dbh.	Total Stems 1" or over	Stems Above 25" dbh.	Species with Frequencies Above 65	Number of Species Represented	Disturbance
1-A	1, 4	9, 10	86.21	896	179	7	1, 8, 4, 6, 2	21	None
1-B	1, 2	10, 9	98.45	1,192	181	9	1, 8, 2	19	None
2-A	11, 2	10	30.68	794	628		11, 2, 6, 10	12	None
2-B	3, 1	1	49.25	1,263	216	5	1, 3, 5	15	None
2-C	6, 11	1	77.86	14	81	1	1	7	Severe pasturing
2-D	3, 1	1	34.25	361	170	3	3, 1	12	Very little
2-E	7, 5	2, 6	27.26	811	168		1, 7, 5, 9	13	None
2-F	2, 8	6, 2	16.40	774	586		2, 6, 8, 12, 7	17	Some years ago
2-G	6, 1	1	50.82	1,046	366	2	6, 1, 7, 11	17	Very little
2-H	1	1, 6	53.29	550	187	3	1, 8, 11	17	Very little
2-I	8	6	45.08	84	567		6, 8	12	Cattle range
2-J	3	9, 1, 3	43.32	389	373	1	3, 13, 1	18	None
2-K	2, 6	1	32.14	746	172		2, 6, 8	12	Slight cutting
2-L	7	10, 1	80.87	4	71	6	None	10	Pasturing and cutting
2-M	1	1, 10	62.62	20	135	2	1	11	Cutting years ago
2-N	1, 7	1	102.90	159	121	6	1	13	Pasturing and cutting
2-O	1, 6	9, 1	98.26	537	147	10	1, 6, 4, 7	11	Some recent cutting
2-P	3	1, 8	76.43	723	364	4	2, 7, 12, 1	15	Cutting years ago
3-B	2, 7	6, 2, 12, 9	29.04	498	511		2, 7, 1, 6, 12	19	Cutting years ago
3-D	2, 8	2, 6, 1, 9	25.15	679	518		2, 7, 14, 8, 12, 6, 1	19	Cutting years ago