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A comparative ecological study of two forest stands in the Illinoian Drift Plain area of southern Indiana

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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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A COMPARATIVE ECOLOGICAL STUDY OF TWO FOREST STANDS IN THE ILLINOIAN DRIFT PLAIN AREA OF SOUTHERN INDIANA[1]

By JACK B. SECOR

The rather uniform till plain topography of Indiana would seem, naturally, to imply a homogeneity and uniformity in the plant cover; such, however, is not the case. Friesner (4) has indicated that the state is in a critical location in reference to the distribution and geographical limitations of numerous and varied plant species.

These vegetational differences are especially marked when forest types within the deciduous forests are involved. Potzger (16) has found that microclimatic features are of sufficient importance to vary expression in oak-hickory or beech-maple type by the mere difference of south- or north-facing ridge exposures.

Because of the critical location of Indiana in the scheme of plant distribution, numerous studies have been made of various forest cover stands throughout the state. The important eastern "flats" region of the topographically uniform Illinoian Till Plain, located in the southeastern part of the state, has not been neglected in this respect (1, 8, 12). In spite of previous work on forests located here, the two forest stands discussed in this paper seemed sufficiently different in external expression to warrant such a comparative study.

Quantitative and qualitative studies of these forest remnants have given an insight into factors controlling the ecesis and development of plant community members, and have also helped to give a better understanding of the true nature of the forest types represented in Indiana. Weaver and Clements (21) list the beech-maple and oak-hickory associations as climax in the general region under study. A committee of the Society of American Foresters (20) placed the Indiana "flats" into the beech type of forest, with the beech pure or predominating. More recent investigation, however, has led to a revision of these concepts. Deam (3) has mapped the various floral

[1] A portion of a thesis submitted in partial fulfillment of the requirements for the degree Bachelor of Seience, magna cum laude, Butler University.

areas of the state, and Braun (1), McCoy (12) and Keller (8) have indicated that even on the Illinoian Till Plain there occurs a wide variation in forest composition. The comparative ecological study presented in this paper serves to further substantiate these findings, and may also give added information about factors controlling forest development in the area.

LOCATION OF THE TWO WOODED AREAS

The two forest stands are located in Jennings County, in that section of the Illinoian Till Plain known as the eastern "flats." The R. H. Deputy woods is located on the east side of road 3, 6 miles south of the junction of roads 3 and 7. This is a mature stand containing numerous large beech, many of which are dying at the top. The soil is well drained by a small stream, and is cut into by a ravine near the southwest corner. The area is fairly level, and raised about 15 feet above stream level. Mr. Deputy informed us that he has owned the tract for over 40 years, and that nothing has been cut from it during his ownership. Formerly, some black walnut and tulip poplar had been removed. The second stand, known as the A. Biehle woods, is located on the west side of road 3, 4.5 miles south of the junction of roads 3 and 7. This area is very flat and poorly drained.

GEOLOGY AND PHYSIOGRAPHY OF JENNINGS COUNTY

According to Malott (10), Jennings County belongs to the till plains section of the Central Lowland province of the United States, and is a part of the Muscatatuck Regional Slope in southern Indiana. During Pleistocene times, continental glaciation brought about physiographic modifications throughout most of Indiana, obliterating much of the erosional surface features formed after the Cincinnati Arch uplift. Of the three recognized glacial invasions (Illinois, Early and Late Wisconsin), the Illinoian was the most extensive, reaching the Ohio River, but leaving unglaciated approximately 6,250 square miles (10) in the south central portion of the state. The two lobes of the Illinoian Till Plain, which are still exposed, comprise 3,100 square miles in the eastern "flats" region, and 4,100 square miles in the western lobe (10).

The Muscatatuck Regional Slope is an upland plain developed on Silurian and Devonian formations, and a thin covering of Illinoian glacial drift has helped to smooth the preglacial relief (11).

The 1940 Soil Survey (9) indicates that the county soils are leached and belong to the Gray Brown Podzolic soils group (11). These soils are characteristic of regions with a humid, temperate climate and a forest cover. On flat or poorly drained timberland, Planosols (claypan soils) have developed, which are soils characteristic of extreme formation. These soils are identifiable through their production of "heavy" horizons in most areas, the almost impenetrable layers preventing subdrainage. They are believed to represent the extreme in profile development, and owe their character primarily to the influences of relief and time, although climate and native vegetation are of minor importance.

The most widespread soil type in the county is Clermont silt loam. characterized by its light brown color and distinctly acid reaction. Owing to the small relief and impervious lower horizons of this soil, very poor drainage is in evidence wherever it is present. Silt loam is unfavorable to the growth of crops, but its topographical uniformity makes it easy to cultivate without erosion difficulties or fertilizer loss. Soil improvements, such as liming and drainage increases, have been carried out locally.

The soils in both the Deputy and Biehle woods appear to be of the Clermont silt loam type, and the soil of the latter stand appeared to be slightly more compact.

CLIMATE AND RAINFALL

According to the 1940 Soil Survey (9), Jennings County has a typical continental climate, with hot summers and moderately cold winters. Periods of extreme cold generally last only a few days. Rainfall is fairly well distributed throughout the year, but occasional dry weather in the late summer or fall is injurious to crops. The following chart, taken from the records of the United States Weather Bureau station at Butlerville, gives a summary report of precipitation in Jennings County over a period of several years:

PRECIPITATION

Season	Total for Driest Year	Total for Wettest Year	Mean	Snow (Av. Depth)
Winter	4.83 in.	13.54 in.	11.30 in.	19.6 in.
Spring	5.13	15.69	13.68	4.8 in.
Summer	11.68	13.38	12.18	0.0 in.
Fall	6.11	18.75	10.31	1.1

The average frost-free season extends from April 26 to October 14, a period of 171 days. Records are available, however, which indicate that frost has occurred as late as May 26, and as early as September 16. Injury from frost is greater in the lowlands than on the higher ground.

METHODS

This study is based upon data obtained from forty-five 100-square-meter quadrats, soil moisture percentages available from weekly soil samples, and from weekly evaporation figures collected at eight stations set up in the two stands.

Quadrats were run in two parallel sectors, 10 meters apart. A total of 25 quadrats were taken in the Deputy woods, and 20 in the Biehle stand. Quadrats were laid out by means of a cord with loops ten meters apart, and the loops were slipped over stakes to form the corners of the areas to be recorded. A skip of ten meters separated each quadrat.

Wooden calipers were used in making the DBH. measurements. All stems over one inch in diameter were measured and recorded. Stems with a diameter of less than one inch and one meter or more in height were also counted. The quadrat study was made on February 1, 1947 (table I).

Three one-eighth acre quadrats were taken in a similar manner on December 13, 1947, one in the Deputy woods and two in the Biehle woods. Results of these quadrat surveys are presented in table II. Tables include diameter size-classes, frequency index, basal area, basal area per acre (approx.), and abundance. Stems under one inch DBH. were not included in the basal area computations, but were presented to show what is occurring in the dynamics of reproduction.

Weekly evaporation was obtained by means of eight Livingston clay bulb atmometers. Four atmometer stations were established in each woods. Stations A, B, C and D were located in the Deputy woods, and E, F, G and H in the Biehle stand. In the Deputy woods, the atmometers were placed firmly in the ground in various areas of predominant beech consociations throughout the stand. The Biehle stations were set up in the following areas:

Station E—Under a large pin oak.
Station F—Under a large beech.

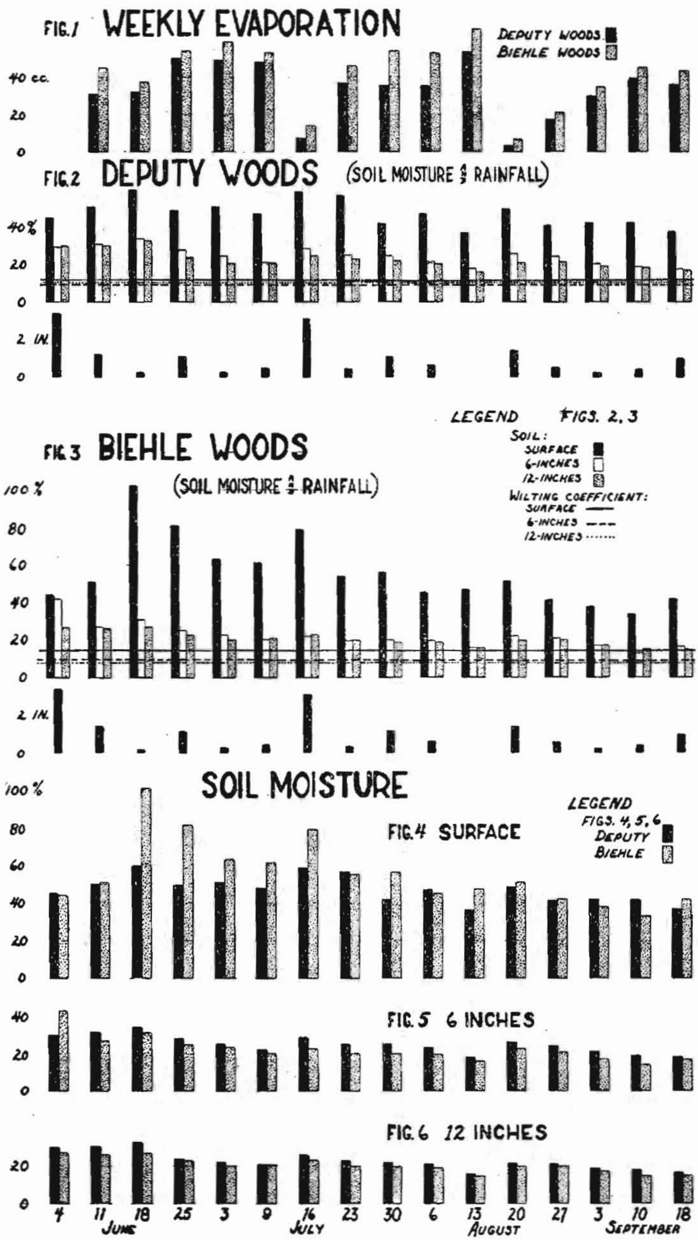
FIG. 1 WEEKLY EVAPORATION
DEPUTY WOODS
BIEHLE WOODS
40 cc.
20
0
FIG. 2 DEPUTY WOODS (SOIL MOISTURE & RAINFALL)
40%
20
0
2 IN.
0
LEGEND FIGS. 2, 3
SOIL:
SURFACE
6-INCHES
12-INCHES
WILTING COEFFICIENT:
SURFACE
6-INCHES
12-INCHES
FIG. 3 BIEHLE WOODS
(SOIL MOISTURE & RAINFALL)
100%
80
60
40
20
0
2 IN.
0
SOIL MOISTURE
100%
80
60
40
20
0
FIG. 4 SURFACE
LEGEND
FIGS. 4, 5, 6
DEPUTY
BIEHLE
40
20
0
FIG. 5 6 INCHES
FIG. 6 12 INCHES
20
0
4 11 18 25 3 9 16 23 30 6 13 20 27 3 10 18
JUNE
JULY
AUGUST
SEPTEMBER

Station G—Under a sweet gum.
Station H—In a beech opening.

Atmometers were re-filled on successive weeks from June 4 to September 18, 1947. In figure 1, the weekly water losses have been averaged in each tract, and a comparison made of weekly evaporation in the two stands.

Weekly soil samples were also taken, two sets at each station. Two samples were obtained at each level (surface, 6-inch, 12-inch). These were weighed in the laboratory, placed into the oven for a suitable period (72 hours), and then removed and reweighed to determine the percentage of soil moisture. Figures 2 and 3 indicate the average weekly soil moisture in each woods at the three levels, as correlated with weekly rainfall in the area. Figures 4-6 compare these soil moisture percentages in both tracts at each level (surface, 6-inch, 12-inch).

Wilting coefficients of the three soil horizons were also included in the computations, and are presented in table IV. The wilting coefficient was obtained according to the method proposed by Briggs and Shantz.

The pH of each horizon was determined through the use of a Beckmann pH meter. These pH readings, together with the active acidity, are presented in table III.

Soil organic matter percentages were determined by the loss-on-ignition method, as described by Weaver and Clements (21) (table V).

OBSERVATIONS

Quadrat Study

Twenty-three different woody species were recorded in the Deputy woods survey. These could be grouped according to stem height as: 12 tall trees, 8 small trees, 2 shrubs, and 1 liana. The 23 woody species found in the Biehle woods could be designated as: 12 tall trees, 6 small trees, 2 shrubs, and 3 lianas.

The dominant tall tree species in the Deputy tract, in their decreasing order of importance according to basal area, are as follows: *Fagus grandifolia* (20,312 sq. in), *Acer saccharum* (1,301 sq. in.), *Liquidambar styraciflua* (708 sq. in.), and *Liriodendron tulipifera* (283 sq. in.) (table II). *Acer saccharum* and *Fagus grandifolia* show the highest frequency (100%), followed by *Carya ovata* (68%), *Liquidambar styraciflua* (48%), *Fraxinus americana* (44%), and *Ulmus americana* (44%) (table I).

Other woody species showing high frequencies are: *Asimina triloba* (60%), *Cornus florida* (52%), *Prunus serotina* (50%), and *Sassafras albidum* (44%) (table I).

In the Biehle woods, the dominant tall tree species are: *Fagus grandifolia* (6,592 sq. in), *Quercus borealis* v. *maxima* (2,961 sq. in.), *Liquidambar styraciflua* (1,872 sq. in.), *Acer rubrum* (1,261 sq. in.), and *Nyssa sylvatica* (442 sq. in.) (tahle I). *Fagus grandifolia* and *Carya ovata* showed the highest frequency among the tall tree species (95%), followed by *Nyssa sylvatica* (65%), *Liriodendron tulipifera* (60%), *Liquidambar styraciflua* (55%), and *Acer rubrum* (55%) (table I).

High frequencies were also recorded for *Lindera benzoin* (80%), *Asimina triloba* (60%), *Fraxinus americana* (55%), and *Smilax* spp. (50%).

Acer saccharum showed the greatest abundance of stems below one inch DBH. in the Deputy woods. *Acer* totalled 870 stems, and was followed distantly by *Fagus grandifolia* (263) and *Asimina triloba* (131). A total of 1,580 small stems were recorded in the Deputy tract.

In the Biehle stand, greatest stem abundance below one inch DBH. was exhibited by *Asimina triloba,* which had a total of 207 stems. *Asimina* was followed by *Fagus grandifolia* (53), *Carya ovata* (53), and *Fraxinus biltmoreana* (43). A total of 746 small stems were recorded, indicating that approximately 932 stems would have been counted if 25 quadrats had been taken, as in the Deputy stand.

In total abundance, *Acer saccharum* (935) and *Fagus grandifolia* (321) are predominant in the Deputy woods, but in the Biehle tract the small tree (or shrub) *Asimina triloba* records highest abundance (221), followed by *Fagus grandifolia* (82), *Fraxinus biltmoreana* (51), *Fraxinus pennsylvanica* (38), *Nyssa sylvatica* (36), and *Liriodendron tulipifera* (30).

The one-eighth acre surveys indicate that Fagus is predominant in basal area in both the Deputy and Biehle stands, with *Liquidambar styraciflua* high in this respect in both tracts. *Acer rubrum* is prominent in the Biehle woods, but its presence is negligible in the Deputy stand (table II).

Edaphic Factors

Highest soil moisture content occurs in the surface layer (figures 2-4). This is especially noticeable in the Biehle woods. Generally, soil moisture decreases with increasing depth, although the differences are not great, and in some instances, as in the Biehle tract, the 12-inch layer showed slightly more moisture content than the 6-inch at certain periods (figure 3). Results further indicate that there is very little correlation between rainfall and soil moisure, except in cases of extreme weekly precipitation (figures 2 and 3).

Figures 4-6 show that, with the exception of the surface layer, the Biehle woods generally recorded lowest soil moisture throughout the entire period of observation. Soil at 6- and 12-inch depths was marked by absence of erratic sudden changes so prevalent in the surface horizon. Soil moisture relations were favorable for the entire season, since available water never dropped below the wilting coefficient (figures 2 and 3). Wilting coefficient figures indicate that the Deputy woods is slightly higher at all soil horizons (table IV).

The soils were found to be slightly acidic (table III), but very little variation was observable either between tracts or between horizon levels. Results of organic content tests show that while there are slight differences in the forest stands at the three levels, these differences do not appear to be sufficient to have directly caused the vegetational variations in the two areas (table V).

Evaporation

Results (figure 1) indicate that evaporation was higher in the Biehle stand during the entire period of observation. Both tracts followed, rather closely, the same evaporational fluctuations, and the high for the two stands was recorded on August 13, 1947.

DISCUSSION

Quadrat Study

Deputy Woods

The more recent work of McCoy (12) and Keller (8) in the "flats" region of Indiana has led to an hypothesis that the forests in this area represent mixed-mesophytic transitional types between the flood plain and near climax formations. The results of this survey appear further to substantiate this conclusion regarding the transitional nature of the Illinois Till Plain forest, and may also aid in the emphasis of certain factors only briefly discussed in previous papers.

From the survey results, one might assume that the Deputy woods is a more or less climax formation as described by Friesner and Potzger (18) for the central Indiana area, with Fagus dominant and *Acer saccharum* in an inferior position but eventually gaining co-dominance, and becoming associated, with Fagus. However, as previously noted, many of the larger Fagus appear to be in a decadent condition, possibly as a result of a lowering of the water table, since the soil is well-drained by a small stream, and is cut into by a ravine near the southwest corner. This has resulted in dessication of the crown cover and entrance of numerous other tall tree species possibly heretofore barred from participation because of light conditions.

The great number of small stems counted (1,580) also definitely points to a woods which has by no means reached the climax stage. Potzger (14) has found that a mature forest supports less than 300 stems per acre, and the Deputy stand has a considerably higher number. Potzger, Friesner, and Keller (19) found that in a forest primeval, a well-developed small tree understory is lacking, and the shrub layer is dominated by one species, *Asimina triloba.* Table I indicates that *Asimina triloba* is prevalent, but that a definite small tree layer is in the process of development.

The high frequency of Fagus and Acer (100%) gives indication that both may form the climax association. The great number of *Acer saccharum* stems, especially in the smaller size classes, bears out the findings of Potzger and Friesner (18), who noted that Acer often greatly outnumbered Fagus in stem totals, but that a majority of the stems were less than one inch in diameter. This would seem to indicate that Acer has excellent reproductive powers, but that its mortality is high as evidenced by the lack of larger stems. Representation of Fagus in small stem size-classes, however, is greater than previously noted (18), giving further indication that *Acer saccharum* and *Fagus grandifolia,* allied with certain other mesophytic tree species (13), may eventually reach the climax condition if left undisturbed.

Biehle Woods

Results of quadrat studies (table I) indicate that the Biehle stand probably closely approximates the Deputy tract in age, with vegetational differences possibly resulting from the action of man, as well as from various edaphic and topographic factors to be discussed later. This observation is based upon the number of stems over 20 inches DBH (table I). The Deputy tract shows the greatest number of stems above this figure but species representation in this class is greater in the Biehle stand.

It is interesting to note that Fagus is again a prominent species, although the area is poorly drained, and from a casual inspection appears to present edaphic factors quite different from those prevalent in the Deputy stand. This characteristic of Fagus to ecese in a wide range of habitats under abundant moisture conditions has been noted by McCoy (12) in his study of the "flats," and by Potzger (15) for the flood-plain and north-facing slopes of flanking uplands in the Salt Creek Valley in Monroe County, Indiana.

The complete absence of *Acer saccharum* is noticeable, its place in the association being taken by *Acer rubrum* (table I). The adaptability of *Acer rubrum* to variable edaphic conditions is brought out in McCoy's (12) study of the area.

Quadrat surveys of both areas show them as stands which, while containing mature tall tree species, are still in the process of development and succession.

Edaphic Factors

Soil moisture percentages (figures 2-6) and wilting coefficients (table IV) indicate the possible importance of edaphic faetors as controlling and regulating elements in a plant community. Other soil moisture studies have been carried out in the state, especially in connection with microclimate as it effects Fagus-Acer and Quercus-Carya communities (6, 16), and Tsuga and Tsuga-Pinus forest associations (7). While soil moisture is probably of prime importance as a controlling factor in the "flats" area, results indicate that the surface layer may be the most "critical" soil horizon in this respect. Figures 5 and 6 show that the poorly-drained Biehle stand had a slightly lower water content at the 6- and 12-inch horizons, whereas in the surface layer this same area had considerably higher moisture content throughout most of June and July, 1947 (figure 4).

This would seem to indicate that soil moisture alone is not the controlling edaphic factor in ecesis, but that drainage and soil structure also are of equal importance. From a visual inspection of the soils, it was observed that the Biehle 6- and 12-inch horizons exhibited more compactness. Since the two stands showed only slight variation in organic content (table V), it appears likely that soil structure also plays its part in the ecesis of woody species in the "flats" area.

Daubenmire (2) states that colloidal structure, resulting in aggregates, is quite essential for plant growth, since it makes the soil permeable to water, air, and rootlets, while at the same time giving it high water- and nutrient-holding capacities. Because of the poor drainage and compact condition of the clay soil in the Biehle woods, the entrance or runoff of surface water is retarded; consequently, a large proportion of this water remains on or in the upper soil layer, from which it is slowly removed through evaporation and any slight surface drainage available. The presence of this surface water, especially in the spring and early summer, combined with an inadequate oxygen supply for the roots, perhaps prevents the entrance and ecesis of woody species requiring a more mesophytic habitat, particularly *Acer saccharum.*

Friesner and Ek (5), in their study of microclimate and species distribution in Shenk's woods, felt that soil aeration was probably the critical factor limiting *Acer saccharum.* Friesner and Potzger (18), while surveying central Indiana forests, noted that *Acer saccharum* ranges from mesophytic to drier habitats, but rarely invades, with success, more hydrophytic areas. Their observations, combined with the findings of this survey, make it seem improbable that *Acer sac-*

charum will ever invade the Biehle stand as long as drainage and soil conditions remain as they are at present.

PH readings show that the soils are acid, but that very little variation is present in the horizons of the two contrasted stands. It is possible, however, that this acid condition may have an effect upon soil structure, since Daubenmire (2) states that often, where forest soils are acid, there is a rather slow conversion of organic debris into humus.

Weekly rainfall apparently had no striking effect upon soil moisture, except when precipitation totalled 1.5-2.0 inches or more (figures 2 and 3). Potzger (15) observed this same condition in various forest tracts throughout Monroe County, Indiana.

Evaporation

Weekly evaporation was greater in the Biehle stand (figure 1). It should be remembered, however, that these figures do not give a complete picture of crown cover evaporation, but are more suitably indicative of the shrub and young tree strata. Potzger (17) found that air currents are probably the most important single factor in controlling and regulating forest humidity. In his study of mosses, Potzger noted that localities with dense shrub layers, especially at forest borders, suffered less water loss than comparable areas where shrub under-stories were wanting. The Deputy woods lacked a well-developed shrub layer, but the great number of young trees might have a similar modifying effect upon the surrounding atmosphere.

SUMMARY AND CONCLUSIONS

1. Presented in this paper are results of a comparative ecological study of two forest stands in Jennings County, situated in the Illinoian Drift Plain area of southern Indiana.

2. Results are based upon 100-square-meter quadrat studies, one-eighth acre quadrats, soil acidity, soil moisture and organic content, wilting coefficients and evaporation data.

3. The Deputy stand, situated in a well-drained area, has a crown cover controlled primarily by Fagus. Many of the larger Fagus, however, are in a decadent condition, which possibly has allowed for the entrance and establishment of numerous other tall tree species. These are represented in the smaller size classes, with *Acer saccharum* high in this respect. Fagus is also high in number of young stems.

4. Indications are that, if not disturbed, the Deputy woods will reach the climax condition with *Fagus grandifolia* and *Acer saccharum* as dominants in the vegetation.

5. In the poorly-drained Biehle stand, the crown cover is dominated primarily by Fagus, but with *Quercus alba, Q. borealis maxima, Nyssa sylvatica, Liquidambar styraciflua,* and *Acer rubrum* showing prominently in the quadrat survey. *Acer saccharum* is absent, being replaced by *Acer rubrum.* Fagus is high in number of young stems.

6. Soil moisture data indicate that the surface horizon may be the most "critical" soil layer in this respect.

7. Weekly rainfall had no decided effect upon soil moisture, unless precipitation totalled 1.5-2.0 inches or more.

8. The pH readings show that the soils in both woods are acid, but that very little variation occurs between the two tracts or the three horizons (surface, 6-inch, 12-inch).

9. In 1947, soil moisture was sufficient in both areas for plant growth, since it never dropped below the wilting coefficient at any time during the 4-month survey.

10. Evaporation data show the Biehle area as having the greatest weekly water-loss, and both stands followed the same weekly evaporational fluctuations. It seems likely that the rather dense under-story of small trees in the Deputy woods reduced evaporation in that area.

11. Organic content tests suggest that soil structure rather than organic content is of primary importance in the ecesis of woody species in the "flats" area.

12. Soil survey figures point to drainage, soil aeration, and surface moisture as predominantly influencing the entrance and ecesis of various tree species, especially *Acer saccharum;* therefore, it seems likely that as long as drainage and soil structure remain as they are at present in the Biehle stand, *Acer saccharum* will not successfully invade this area.

13. These two forest stands have provided important comparative information on certain edaphic factors which seem to exert a regulatory influence over the vegetational dynamics of the area. It is felt that, if left undisturbed, these tracts will offer interesting supplementary ecological facts at a later date.

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TABLE I

Stems in 25 100-sqm. quadrats in Deputy Woods (D) and 20 100-sqm. quadrats in Biehle Woods (B).

Species		Below 1"	1	2	3-5	6-10	11-15	16-20	Over 20	Total stems above 1"	F. I.	Basal Area sq. in.	Basal Area per Acre sq. in.
Acer rubrum	D	1									4		
	B	7	1	2	8	4	1	2	1	19	55	1261.9	2523.8
A. saccharum	D	870	43	16	2			3	1	65	100	1301.1	2081.8
	B												
Aralia spinosa	D												
	B	17	9							9	10	7.1	14.1
Asimina triloba	D	131	13	3						16	60	19.6	31.4
	B	207	13		1					14	60	17.3	34.5
Carpinus caroliniana	D	10		1						1	16	3.1	5.0
	B												
Carya ovata	D	23	1	1						2	68	3.9	6.3
	B	53	14	7	5	1				27	95	157.0	314.1
Celtis occidentalis	D	8									24		
	B												
Cornus florida	D	27	3							3	52	2.4	3.8
	B		1							1	5	0.8	1.6
Fagus grandifolia	D	263	4	1		1	10	13	29	58	100	20312.9	32500.7
	B	53	4		1		6	11	7	29	95	6592.2	13184.3
Fraxinus americana	D	45		1						1	44	3.1	5.0
	B	12	3							3	55	2.4	4.7

TABLE I—(Continued)

Stems in 25 100-sqm. quadrats in Deputy Woods (D) and 20 100-sqm. quadrats in Biehle Woods (B).

Species		Below 1"	1	2	3-5	6-10	11-15	16-20	Over 20	Total stems above 1"	F. I.	Basal Area sq. in.	Basal Area per Acre sq. in.
F. biltmoreana	D	5	2		2					4	20	15.7	25.1
	B	43	8							8	35	6.3	12.6
F. pennsylvanica	D												
	B	38									35		
Juniperus virginiana	D	22									36		
	B												
Lindera benzoin	D												
	B	207									80		
Liquidamber styraciflua	D	32	2						1	3	48	708.3	1133.3
	B	5			2	1	6	1	2	12	55	1872.0	3744.1
Liriodendron tulipifera	D	4						1		1	12	283.5	453.6
	B	26	3			1				4	60	80.9	161.8
Morus rubra	D	5									16		
	B	4									15		
Nyssa sylvatica	D	6									12		
	B	22	2	1	4	6	1			14	65	442.1	884.2
Ostrya virginiana	D	1									4		
	B												
Prunus serotina	D	35	5	1						6	50	7.1	11.3
	B	1									5		

TABLE I—(Continued)

Stems in 25 100-sqm. quadrats in Deputy Woods (D) and 20 100-sqm. quadrats in Biehle Woods (B).

Species		Below 1"	1	2	3-5	6-10	11-15	16-20	Over 20	Total stems above 1"	F. I.	Basal Area sq. in.	Basal Area per Acre sq. in.
Quercus borealis	D	10	2	1						3	32	14.1	22.6
v. maxima	B								4	4	25	2962.0	5924.0
Q. alba	D												
	B	3			1	1	1			3	25	224.6	449.7
Rhus radicans	D	1									4		
	B												
Rubus sp?	D												
	B	1									5		
Sambucus canadensis	D	3									12		
	B	4									10		
Sassafras albidum	D	20	2	1		1				4	44	33.0	52.8
	B	25									35		
Smilax sp?	D	25									24		
	B	120									50		
Ulmus americana	D	33	12	2	1					15	44	22.8	36.4
	B	2	1		1					2	20	7.9	15.7
Vitis sp?	D												
	B	2	1	1						2	5	3.9	7.9

TABLE II

Results of two one-eighth acre areas in Biehle Woods (B) and one one-eighth acre area in Deputy Woods (D).

Species		Below 1"	1	2	3-5	6-10	11-15	16-20	Over 20	Total Stems 1" and Above	Approx. Basal Area Per Acre (Sq. In.)
Acer rubrum	B	3	1	3	13	7			1	25	3,844.57
A. saccharum	D	346									
Asimina triloba	B	53									
	D	102									
Aralia spinosa	B	3									
Carpinus caroliniana	D	7									
Carya ovata	B	20	3	4	1	3				11	568.52
	D	3									
Cornus florida	B	1									
Evonymus atropurpureus	B	1									
Fagus grandifolia	B	35	2	1			2	7	3	15	13,012.06
	D	14				3	3	3	5	14	30,373.5
Fraxinus	B	25			1					1	50.26
americana	D	14									
Lindera benzoin	B	366									
Juniperus virginiana	D	1									
Liquidambar	B				2	9				11	2,296.07
styraciflua	D	4							1	1	4,579.6
Liriodendron	B	4	2		1					3	84.80
tulipifera	D	1									
Morus rubra	B	3									
	D	2									
Nyssa sylvatica	B				1					1	78.52
Ostrya virginiana	B	4									
Quercus prinus	B					1				1	201.02
Q. palustris	B					1				1	201.02
Sambucus	B	2									
canadensis	D	3									
Sassafras	B	8									
albidum	D	1									
Smilax sp.?	B	30									
Ulmus americana	B			1	1					2	62.82

TABLE III

Soil Acidity in terms of Active Acidity (A) and pH (H).

Soil Levels		Deputy Woods Stations A	B	C	D	Av.	Biehle Woods Stations E	F	G	H	Av.
Surface	A	12.5	11.9	8.0	8.2	10.14	8.6	18.1	5.6	16.1	12.12
	H	5.90	5.95	6.12	6.09	6.0	6.07	5.75	6.24	5.80	5.92
6-inch	A	7.1	8.4	17.9	10.1	10.87	7.7	8.3	10.8	11.1	9.46
	H	6.14	6.08	5.75	6.01	5.97	6.10	6.09	5.97	5.96	6.03
12-inch	A	10.7	8.2	15.9	11.7	11.62	9 5	9.2	10.16	11.7	10.14
	H	5.97	6.09	5.80	5.93	5.94	6.03	6.04	6.00	5.93	6.00

TABLE 1V

Wilting Coefficients in percentages.

Soil Levels	Deputy Woods Stations A	B	C	D	Av.	Biehle Woods Stations E	F	G	H	Av.
Surface	12.60	11.81	13.76	12.55	12.68	13.27	11.11	14.22	10.20	12.20
6-1nches	10.63	9.43	10.13	8.96	9.78	9.01	8.20	8.33	9.56	8.77
12-1nches	11.18	10.71	10.00	8.84	10.18	8.44	8.28	8.08	8.78	8.39

TABLE V

Organic content of the soil in percentages.

Forest Stands	Soil Levels Surface	6-Inches	12-Inches
Deputy	7.74	3.67	2.77
Biehle	8.63	3.32	2.80