

Composition of the Forest Primeval from Hendricks County Southward to Lawrence County, Indiana¹

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The basis of this forest study are the field notes of the surveyors who made the original United States land survey between 1800 and about 1835. These men recorded two "witness trees" at each section and quarter section corners. The common name and the trunk diameter of these trees were given. This procedure placed on record from 2,500 to 4,000 trees for a county. In discussing the importance of the various species or genera in the forest composition, percentage of the total number of stems recorded are used (Tables I, II, III, IV). Usually 34 to 40 species and genera are listed for a given county.

In spite of the numerous field studies made on the phytosociology of Indiana forests, and on climax forest characteristics for the state as a whole, the old Zon (5) map, which places Indiana into the oak-hickory climax, creeps into modern botany texts. Other writers do not go to this extreme but they place the unglaciated section of the state into the oak-hickory climax. Because of such misunderstandings about the Indiana forests the present study has been made to include an area which is representative of both the level glaciated and rugged unglaciated sections of Indiana.

The most prominent single feature of the study is the almost universal important place occupied by *Fagus grandifolia* (beech); in some townships this species represented 60 per cent of the total stems recorded. In the more mesic areas, such as Hendricks County, the chief associates are *Acer saccharum* (sugar maple) and species of *Fraxinus* (ash); however, usually also present in lower percentages were *Nyssa sylvatica* (black gum), *Juglans nigra* (black walnut), *J. cinerea* (white walnut), *Liriodendron tulipifera* (tulip poplar), *Ulmus* spp. (elms), *Cornus florida* (flowering dogwood), *Cercis canadensis* (redbud), *Carpinus* (water beech), *Tilia* (linden, lynn), *Morus* (mulberry), *Prunus serotina* (black cherry) and occasionally *Sassafras*. In the rugged areas *Castanea* (chestnut) appeared. Of course, universally associated in varying degrees were species of *Carya* (hickory) and *Quercus* (oak). Tables I to IV also show that tabulations of individual townships accentuate much more the characteristic of segregation of species into forest cover types than is shown by groupings of whole ranges of

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TABLE I. Representation of stems in terms of percentage which a species or groups of species had of the total number of stems recorded for Hendricks County, Indiana

| Species | T. 14 N. | | | | T. 15 N. | | | | T. 16 N. | | | | T. 17 N. | | | | | | | |
|--------------------------------|----------|------|------|------|----------|------|------|------|----------|------|------|------|----------|------|------|------|------|------|------|------|
| | R. | R. | R. | R. | R. | | | |
| | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | | | |
| Acer saccharum..... | 18.0 | 15.4 | 10.0 | 11.9 | 11.2 | 13.2 | 21.2 | 22.1 | 21.2 | 13.3 | 11.2 | 14.0 | 9.8 | 9.9 | 3.4 | 19.0 | 24.7 | 40.5 | 31.0 | 39.2 |
| Fagus grandifolia..... | 42.3 | 38.0 | 54.0 | 43.3 | 42.0 | 40.7 | 37.8 | 52.3 | 43.3 | 33.6 | 48.8 | 45.6 | 44.3 | 12.3 | 12.4 | 17.0 | 8.5 | 12.3 | 12.4 | 17.0 |
| Fraxinus spp..... | 11.7 | 9.3 | 8.5 | 6.1 | 9.3 | 7.3 | 10.0 | 4.0 | 3.8 | 10.6 | 8.1 | 11.1 | 3.8 | 12.3 | 12.4 | 17.0 | 8.5 | 12.3 | 12.4 | 17.0 |
| Carya spp..... | 7.2 | 1.6 | 1.0 | 10.3 | 12.1 | 8.6 | 3.5 | 7.7 | 4.0 | 9.7 | 6.5 | 4.5 | 11.8 | 11.1 | 4.1 | 8.7 | 4.0 | 11.1 | 4.1 | 8.7 |
| Quercus alba..... | 4.5 | 7.7 | 5.5 | 6.4 | 4.6 | 3.6 | 7.0 | 2.3 | 2.3 | 7.0 | 5.8 | 7.6 | 5.1 | 16.0 | 10.3 | 6.8 | 6.4 | 16.0 | 10.3 | 6.8 |
| All other Quercus species..... | 0.9 | 0.6 | 3.4 | 3.3 | 0.9 | 3.4 | 1.6 | 2.3 | 2.3 | 1.7 | 1.9 | 4.5 | 2.6 | 1.2 | 2.5 | 7.7 | 4.4 | 1.2 | 2.5 | 7.7 |
| Liriodendron tulipifera..... | 0.9 | 1.9 | 0.7 | 3.3 | ... | 0.4 | 3.0 | 2.0 | 2.0 | 1.7 | 1.9 | 1.4 | 1.9 | 1.2 | 2.8 | 2.4 | 4.2 | 1.2 | 2.8 | 2.4 |
| Juglans nigra..... | 2.7 | 3.2 | 0.7 | 0.9 | 1.8 | 1.6 | 2.6 | 0.6 | 0.6 | 4.4 | 1.9 | 1.0 | 2.2 | 1.2 | 0.8 | 0.5 | 1.6 | 1.2 | 0.8 | 0.5 |
| Ulmus virginiana..... | 2.7 | 0.3 | 1.0 | 0.9 | 2.8 | 1.6 | 3.0 | 0.3 | 1.9 | 1.7 | 2.0 | 3.5 | 1.9 | 7.4 | 1.2 | 2.4 | 0.4 | 7.4 | 1.2 | 2.4 |
| Stems 32 inches or over..... | 3.6 | 5.7 | 5.5 | 3.3 | 1.8 | 2.0 | 3.0 | 3.0 | 3.0 | 3.5 | 2.6 | 6.3 | 1.6 | 4.9 | 4.5 | 4.0 | 8.3 | 4.9 | 4.5 | 4.0 |
| Floodplain species..... | 1.8 | 7.0 | ... | 3.6 | 4.7 | 2.6 | 1.6 | 0.3 | 0.3 | 1.7 | 1.6 | 1.0 | 1.6 | 2.5 | 1.2 | 6.8 | 3.2 | 2.5 | 1.2 | 6.8 |

TABLE II. Representation of stems in terms of percentage which a species or groups of species had of the total number of stems recorded for Morgan County, Indiana

| Species | T. 13 N. | | | | T. 12 N. | | | | T. 11 N. | | | | | | | | | | | |
|--------------------------------|----------|------|------|------|----------|------|------|------|----------|------|------|------|------|------|------|------|------|------|------|------|
| | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | R. | | | |
| | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | 1 E. | 1 W. | 2 W. | 2 E. | | | |
| Acer saccharum..... | 9.5 | 19.8 | 9.6 | 4.4 | 16.8 | 14.0 | 10.2 | 13.4 | 16.9 | 7.4 | 6.8 | 9.3 | 34.6 | 38.6 | 43.5 | 53.8 | 49.6 | 35.9 | 26.6 | 29.6 |
| Fagus grandifolia..... | 7.4 | 8.9 | 9.2 | 8.3 | 11.2 | 4.5 | 1.7 | 1.6 | 11.1 | 5.2 | 4.7 | 3.1 | 4.2 | 13.2 | 10.0 | 8.9 | 9.5 | 4.5 | 8.3 | 5.4 |
| Carya spp..... | 1.1 | 5.1 | 4.1 | 2.6 | 1.3 | 2.4 | 5.1 | 3.4 | 0.4 | 8.3 | 5.8 | 4.6 | 1.3 | 4.3 | 2.5 | 3.8 | 3.0 | 1.2 | 3.9 | 1.7 |
| Quercus alba..... | 0.7 | 1.4 | 2.5 | 1.3 | 0.8 | ... | 3.8 | 1.7 | 1.7 | 1.2 | 2.2 | 1.3 | 3.1 | 1.4 | 0.5 | 0.4 | 0.6 | 1.2 | 2.2 | 1.3 |
| All other Quercus species..... | 1.1 | 2.8 | ... | ... | 2.2 | 2.4 | ... | 1.1 | 1.2 | 1.7 | 1.7 | 3.1 | 1.6 | 4.3 | 6.5 | 3.1 | 1.6 | 4.3 | 6.5 | 3.1 |
| Liriodendron tulipifera..... | 1.1 | 2.8 | ... | ... | 1.1 | 2.8 | ... | ... | 1.1 | 1.6 | 4.3 | 6.5 | 3.1 | 3.6 | 1.4 | 1.2 | 1.1 | 1.6 | 4.3 | 6.5 |
| Ostrya virginiana..... | 3.6 | 2.8 | ... | ... | 6.9 | 1.4 | 1.2 | 1.1 | 4.1 | 2.2 | 4.1 | 2.3 | 3.6 | 1.4 | 2.5 | 1.9 | 3.3 | 1.7 | 1.7 | 4.7 |
| Ulmus spp..... | 21.5 | 3.3 | 4.6 | 7.7 | 2.6 | 19.6 | 0.4 | 1.1 | 2.5 | 2.6 | 19.6 | 0.4 | 1.1 | 1.2 | 7.9 | 21.8 | 27.3 | 1.2 | 7.9 | 21.8 |
| Stems 32 inches or over..... | 21.5 | 3.3 | 4.6 | 7.7 | 2.6 | 19.6 | 0.4 | 1.1 | 2.5 | 2.6 | 19.6 | 0.4 | 1.1 | 1.2 | 7.9 | 21.8 | 27.3 | 1.2 | 7.9 | 21.8 |
| Floodplain species..... | 21.5 | 3.3 | 4.6 | 7.7 | 2.6 | 19.6 | 0.4 | 1.1 | 2.5 | 2.6 | 19.6 | 0.4 | 1.1 | 1.2 | 7.9 | 21.8 | 27.3 | 1.2 | 7.9 | 21.8 |

TABLE III. Representation of stems in terms of percentage which a species or groups of species had of the total number of stems recorded for Monroe County, Indiana

| Species | T. 10 N. | | T. 9 N. | | T. 8 N. | | T. 7 N. | | | | | |
|--------------------------------|---------------------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|
| | R. 1 E. | R. 2 W. | R. 1 E. | R. 2 W. | R. 1 E. | R. 2 W. | R. 1 E. | R. 2 W. | | | | |
| | Acer saccharum..... | 4.7 | 8.5 | 10.9 | 10.3 | 8.0 | 31.3 | 15.9 | 3.7 | 3.6 | 22.1 | 18.6 |
| Fagus grandifolia..... | 37.2 | 54.6 | 35.9 | 40.9 | 43.8 | 40.3 | 26.2 | 7.4 | 27.0 | 30.6 | 39.4 | |
| Fraxinus spp..... | 0.5 | 4.2 | 6.0 | 1.7 | ... | 3.4 | 3.0 | ... | 0.9 | 0.8 | 4.4 | |
| Carya spp..... | 9.0 | 5.6 | 4.0 | 6.4 | 6.4 | 4.2 | 11.6 | 9.2 | 10.5 | 10.6 | 8.9 | |
| Quercus alba..... | 9.0 | 8.1 | 2.0 | 10.0 | 11.2 | 6.5 | 13.3 | 7.2 | 7.7 | 31.4 | 17.4 | 12.3 |
| All other Quercus species..... | 6.9 | 2.5 | 2.0 | 16.8 | 1.3 | 2.3 | 5.9 | ... | 2.2 | 16.7 | 12.6 | 2.1 |
| Liriodendron tulipifera..... | 4.7 | 0.3 | 2.0 | 2.2 | 2.5 | 0.4 | 0.5 | 0.8 | 4.7 | 3.7 | 3.2 | 2.1 |
| Juglans nigra..... | 0.5 | ... | 0.8 | 0.9 | 1.2 | 1.3 | ... | 0.4 | 1.7 | ... | 0.4 | 1.2 |
| Ostrya virginiana..... | 4.7 | 2.4 | 0.4 | 0.4 | 5.6 | 1.7 | 2.6 | 1.7 | 1.2 | ... | 2.2 | ... |
| Ulmus spp..... | 4.2 | 0.3 | 2.8 | 0.9 | 3.0 | 3.5 | 3.2 | 2.1 | 3.0 | ... | 5.0 | 2.9 |
| Stems 32 inches or over..... | 1.0 | 2.4 | 2.0 | 1.3 | 0.4 | 1.3 | 0.5 | 2.1 | 3.4 | 1.8 | 0.9 | 2.5 |
| Floodplain species..... | 3.1 | 1.7 | 4.0 | 2.7 | 1.2 | 0.8 | 3.2 | 1.2 | 3.0 | 3.7 | 1.3 | 2.5 |

TABLE IV. Representation of stems in terms of percentage which a species or groups of species had of the total number of stems recorded for Lawrence County, Indiana

| Species | T. 6 N. | | T. 5 N. | | T. 4 N. | | T. 3 N. | | | | | | | | | |
|--------------------------------|---------------------|---------|---------|---------|---------|---------|---------|---------|------|------|------|------|------|------|------|------|
| | R. 2 E. | R. 1 E. | R. 1 W. | R. 2 W. | R. 2 E. | R. 1 E. | R. 1 W. | R. 2 W. | | | | | | | | |
| | Acer saccharum..... | 7.5 | 13.7 | 18.6 | 22.8 | 17.6 | 21.1 | 12.5 | 17.9 | 11.1 | 20.0 | 6.3 | 20.1 | 9.7 | 2.6 | 3.8 |
| Fagus grandifolia..... | 41.8 | 43.1 | 43.6 | 40.3 | 51.7 | 52.5 | 48.9 | 45.1 | 39.5 | 32.3 | 19.8 | 44.8 | 9.7 | 11.3 | 9.7 | 44.3 |
| Fraxinus spp..... | 1.2 | 4.8 | 1.9 | 2.2 | 0.6 | 5.8 | 2.1 | 0.4 | 5.5 | 5.2 | 0.3 | 3.0 | 12.1 | 9.5 | 1.9 | ... |
| Carya spp..... | 4.3 | 4.8 | 5.8 | 8.0 | 4.7 | 0.8 | 3.0 | 2.7 | 6.1 | 3.2 | 8.7 | 2.2 | 9.7 | 9.5 | 12.6 | 1.9 |
| Quercus alba..... | 19.4 | 12.4 | 9.8 | 3.1 | 2.7 | 4.4 | 4.3 | 9.2 | 6.1 | 8.1 | 21.8 | 8.0 | 22.0 | 27.0 | 31.0 | 8.6 |
| All other Quercus species..... | 6.8 | 3.6 | ... | 0.9 | ... | ... | 0.8 | 1.8 | 1.3 | 5.3 | 7.5 | 1.5 | 4.8 | 6.9 | 7.4 | 9.6 |
| Liriodendron tulipifera..... | 1.9 | 1.3 | 2.9 | 4.0 | ... | 1.3 | 3.9 | 3.2 | 1.8 | 2.8 | 6.0 | 2.2 | 2.4 | 11.3 | 5.7 | 6.3 |
| Juglans nigra..... | ... | 1.3 | 1.0 | ... | 1.4 | 2.2 | 0.9 | 0.5 | 3.6 | 0.5 | 1.1 | 1.1 | ... | ... | 1.0 | 1.0 |
| Ostrya virginiana..... | 1.9 | 3.1 | 1.9 | 2.2 | 4.0 | 2.2 | 4.8 | 3.2 | 6.7 | 4.8 | 1.5 | 1.1 | 2.4 | ... | ... | 1.9 |
| Ulmus spp..... | 1.2 | 2.6 | 2.9 | 0.4 | 4.0 | 3.1 | 4.8 | 1.3 | 0.6 | 3.3 | 2.7 | 2.2 | ... | 1.7 | 2.9 | 1.0 |
| Stems 32 inches or over..... | 1.2 | ... | 1.5 | 0.4 | 0.6 | 0.4 | ... | ... | 2.5 | 1.0 | 0.3 | 1.1 | 2.4 | 0.9 | ... | 1.0 |
| Floodplain species..... | 1.2 | 0.4 | 3.9 | 1.8 | 1.4 | 1.3 | 1.3 | 1.8 | 9.2 | 2.9 | 1.5 | 4.1 | 7.3 | ... | 4.8 | 1.8 |

townships. Local control, or selection by habitat, is evident even for beech (compare table I with the records in T. 4 N. and T. 3 N. of table IV). In this overall view of a large forested area one sees no evidence of a sharp break between a mixed mesophytic forest cover in glaciated and oak-hickory in unglaciated areas. The data rather point to a mixed mesophytic forest in which the oak and hickory element is more prominent in rugged areas. Most striking of all is the decrease of *Fraxinus* as one proceeds from glaciated to unglaciated sections. Sugar maple and beech fluctuate in a manner that suggests physiographic rather than climatic influence. Potzger and Friesner (2) and Potzger (1, 3) showed such conditions to operate in the rugged sections of Indiana. *Liriodendron tulipifera* and *Juglans nigra* were not very abundant but were represented by massive trees. In the glaciated section of Hendricks County (Table I) *Quercus alba* far outnumbered all other species of oaks. In the glaciated area also trees of 32-inch diameter or over were more numerous than in the rugged unglaciated area, but even here they seldom attained 5 per cent of the total stand. This indicates that the forest primeval was constituted primarily of trees whose diameter of trunk was not strikingly massive. This was the conclusion reached by Potzger and Friesner (4) in their quadrat study of a comparatively little disturbed oak forest. In the tables I to IV floodplain forest designation comprises such species as *Acer negundo* (boxelder), the soft maples, *Platanus occidentalis*, (sycamore), *Celtis occidentalis* (hackberry), *Populus deltoides* (cottonwood), and *Salix* (willow).

Discussion

Descriptions of the phytosociology of forests are not easy to carry out even for a small stand of timber, and the difficulty of such a task mounts as geographical areas widen. In a complex forest cover as we have in Indiana segregation occurs readily with variation in slope exposure and other physiographic changes. This was discussed by Potzger (3) for Ripley County. Slope exposure thus becomes a selective microclimate within an otherwise uniform macroclimate. Potzger and Friesner (2) have pointed this out for the unglaciated areas in the state and discussed in detail the factors which operate. Such local differences may, indeed, be at times of sufficient magnitude to border on macroclimatic significance as Potzger (1) shows for north- and south-facing slopes in Monroe County. If these various local facets are merged in a composite picture, as in the present study, the true climax (climatically controlled) stands out prominently.

It seems to us that the survey data taken uniformly from all types of habitats should present a fairly accurate over-all picture of the *status quo* in a county or series of counties. Since in unglaciated Indiana slope exposure determines the forest cover types, which in its extremes is expressed as oak-hickory on south-facing slopes and mixed mesophytic on more gentle north-facing slopes, it becomes a problem of determining which of the two exposures is most abundant in a given county in

order to know which forest cover is most abundant. We are of the opinion that the records of the surveyors serve this purpose very well. Percentages shown in tables 1-4 justify the conclusion that Morgan, Monroe and Lawrence counties have less area in south-facing slopes than mesic level areas and north-facing slopes, for the over-all picture indicates a mixed mesophytic forest cover with somewhat greater intrusion of the oak-hickory element that in Hendricks County.

Summary

1. Data shown in 4 tables are based on tabulations of trees recorded as witness trees by surveyors of the original United States land survey.

2. Numbers of stems recorded in the several counties included in this study total between 3,000 and 4,000 stems per county

3. Hendricks, Morgan, Monroe and Lawrence counties were included in the study because they are good representative areas of glaciated and unglaciated Indiana. The glacial boundary passes through T. 10 N. in Monroe County.

4. *Fraxinus* decreases in abundance as one proceeds from Hendricks County southward to central Lawrence County.

5. *Juglans nigra*, *Liriodendron tulipifera* as well as stems of large trees (32 inches or over in diameter) seldom attain 5 per cent of the total stems recorded.

6. Percentage representation indicates that the climax forest in all four counties is the mixed mesophytic type. Beech and sugar maple are as a whole the dominant species but oaks and hickories assume a more prominent place in the forest cover of the counties located in the unglaciated area.

7. Listing percentages by townships, as in tables I to IV, accentuates segregation of species into various forest cover types, in which, however, beech and sugar maple usually play a leading role.

Literature Cited

1. POTZGER, J. E. 1939. Microclimate and a notable case of its influence on a ridge in central Indiana. *Ecology* 20:29-37.
2. ——— and RAY C. FRIESNER. 1940. What is climax in central Indiana? A five-mile quadrat study. *Butler Univ. Bot. Stud.* 4:181-195.
3. ———. 1950. Forest types in the Versailles State Park area, Indiana. *Amer. Midl. Nat.* 43:729-741.
4. ——— and RAY C. FRIESNER. 1934. Some comparisons between virgin forest and adjacent areas of secondary succession. *Butler Univ. Bot. Stud.* 3:85-98.
5. ZON, RAPHAEL. 1924. Natural vegetation, Section E, Forests. *Atlas Am. Agr., U. S. Dept. Agr., map.*