

# Pollen frequency of *Abies* and *Picea* in peat: A correction on some published records from Indiana bogs and lakes

J. E. Potzger  
*Butler University*

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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.

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**Butler University**  
**Botanical Studies**  
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*Edited by*

**Ray C. Friesner**

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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# POLLEN STUDY OF FIVE BOGS IN PRICE AND SAWYER COUNTIES, WISCONSIN\*

By J. E. POTZGER

The bogs included here constitute the second unit of a transect westward of Vilas county. The first unit of 4 bogs was discussed by Potzger and Keller (8) in a previous study. The problem was to trace vegetational succession in Wisconsin along a given latitude, and specifically to discover whether *Quercus* became more important in the forest associations towards the western part of Wisconsin than it was in Vilas county and in adjacent Gogebic county, Michigan. The bogs selected are all close to highway 70 as the most suitable westward line from the Trout lake area. Four are located in Price and one in Sawyer county, Wisconsin.

## LOCATION AND DESCRIPTION OF THE BOGS

Figures 1 and 2 present the bogs in successional order, beginning with the easternmost, Sheep Ranch Road bog.

### SHEEP RANCH ROAD BOG

This is a valley type bog, located three miles south of highway 70, on the western side of road 390, or Sheep Ranch Road. At this point it widens into a rather large oval basin but as a whole occupies a rather narrow valley set in between steep uplands. It was with some difficulty that the deepest part of the original basin could be determined. Poorly preserved remnants of the former forest gave the impression that northern hardwoods (*Acer saccharum*, *Tsuga* and *Betula lutea*) constituted the forest cover when civilized man first appeared. A luxuriant growth of *Sphagnum* crowned the surface layer. Westward of the wide basin, in the narrow valley part of the bog, dense stands of *Picea* and *Abies* constituted the forest cover until in 1938 a severe sleet storm completely destroyed it.

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\*This is contribution 144 from the botanical laboratories of Butler University, and notes and reports 118 from the Limnological Laboratory of the Wisconsin Geological and Natural History Survey, University of Wisconsin.

### GRAVEL PIT BOG

This bog is also of the valley type. A stand of small *Picea mariana* and *Larix laricina* constituted the forest cover. Its location is 10.8 miles west of the Oneida-Price county line on highway 70. A steep rocky ridge, almost wall-like, separates it from a similar valley bog not more than 50 feet to the west. A gravel pit bordering the highway on the north was, for want of a better designation, selected as the defining name for the bog.

### SUNKEN HIGHWAY BOG

Approximately 7.2 miles east of Fifield, Price county, old highway 70 crossed the southern end of an extensive boggy depression, and the soft peat has engulfed the highway, leaving a strip of open water. The surface of the bog is covered by a sedge meadow where *Chamaedaphne calyculata* makes its competition felt. In the center is a 100-foot-wide open pool. The inner portion of the bog is in the quaking mat stage. The boring was made about 35 feet from the southern edge of the pool.

### FOUR-MILE LAKE BOG (PLANET LAKE)

A deep-set kettle hole lake is four miles east of Fifield, Price county. A wide mat surrounds the lake which is covered by a dense stand of bog forest in which *Picea*, *Larix* and *Betula papyrifera* play a prominent role. The lake has a several-hundred-foot-wide expanse of open water and was reported to have been sounded to a depth of 60 feet. This indicates that the floor has a steep gradient from the shore to the deepest part of the basin.

### DRAPER BOG

This extensive bog area, too, has a shallow central open pond. Its location is 5 miles northwest of Draper, Sawyer county, Wisconsin. The vegetation on the mat is primarily sedge-meadow with scattered clumps of *Chamaedaphne calyculata*. A dense bog forest covers the periphery of the wide mat which, near the pond where the boring was made, is evidently still in the floating stage, because the borer did not receive the necessary resistance to take samples at the topmost 8 foot-levels.

## METHODS

Borings were made with the open cylinder and movable-sleeve type borer. In every case several soundings were made to determine the deepest part of the basin. The samples for analysis were taken from the center of each core. The peat was placed into bottles which were properly labeled with location and foot-level. No preservative was added. At the laboratory the stoppers were sealed with paraffin to keep the soil moist. Preparation of slides followed closely the Geisler method (2). Two hundred pollen grains of tree genera constituted the count for any given foot-level. Exceptions to this rule were at: Sheep Ranch bog, 22-foot level (50 grains), Draper bog, 28.25-foot level (150 grains), Draper bog, surface level (100 grains).

Pollen of grasses, Compositae, *Alnus*, *Corylus* and *Chenopodiaceae* were tabulated but not included in the count of 200 grains of tree genera.

## RESULTS

All bogs except the one at Four-mile lake record an initial *Picea* period of pronounced prominence. The reason for absence of this period in the bog just named is, no doubt, to be sought in the location of the sampling station on a floor with a steep slant toward the deepest portion of the basin, now occupied by the lake. Such "off-center" borings generally result in a truncated lower portion of the pollen profile, usually eliminating the entire or major portion of the *Picea* period.

A second non-conformity is found in Sunken Highway bog where *Pinus* shows greater abundance than *Picea* in the lowest level, and is replaced in this respect by *Picea* in the succeeding two foot-levels. Decline of *Picea* is, as in all previously studied bogs in Wisconsin, very sudden. In the Sheep Ranch Road bog, between the 19- and 18.5-foot levels *Picea* declined from 62 to 6% (fig. 1). *Pinus* controlled the forest cover during a period of time represented by 75 to 90% of the foot-levels. Only in the Sheep Ranch Road and Sunken Highway bogs is a very decided decline in percentage of *Pinus* pollen recorded. Increases in *Betula* and *Tsuga* account for most of the decline in the prominence of *Pinus* while the topmost levels were accumulating. *Tsuga* is comparatively a very late entrant into the forest complex in Price and Sawyer counties. *Ulmus* shows the greatest representation at the time the broadleaved genera invaded the region,

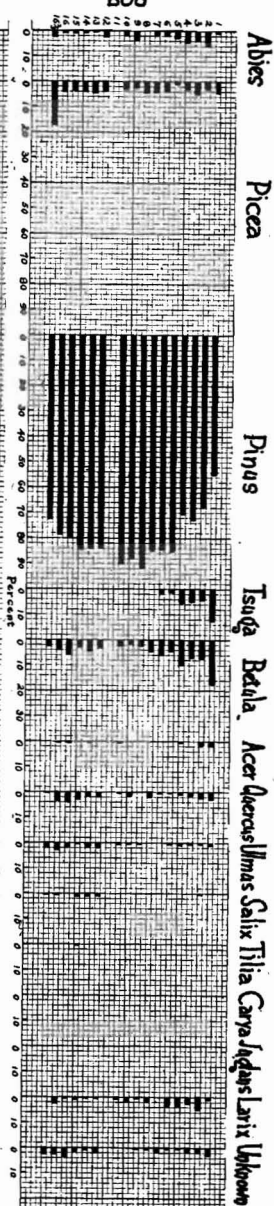
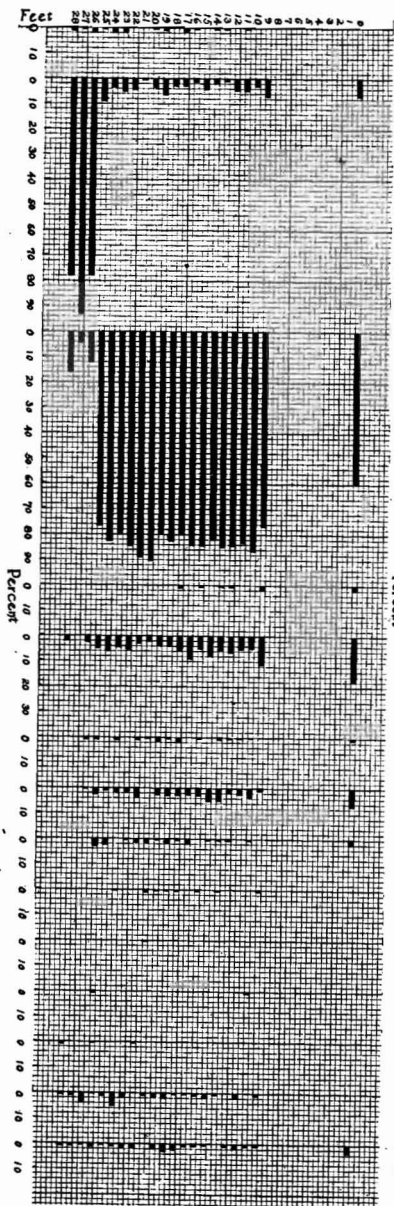
and declined towards the closing foot-levels of the various bogs. *Carya* and *Juglans* appear in a number of levels in all but the Four-mile Lake bog. (*Carya* is also absent in the Sheep Ranch Road bog.) The comparatively small number of foot-levels recording a decided *Picea* period hints at the probability that pollen-bearing sandy layers were of necessity omitted by limitations of action of the sleeve-type borer in sandy deposits. Climatic climax for this part of Wisconsin is evidently also the broadleaved forest and *Pinus* maintains an undisputed dominance only in the poorer sandy soils, reflecting thus, the same status as in the Vilas county neighborhood.

## DISCUSSION

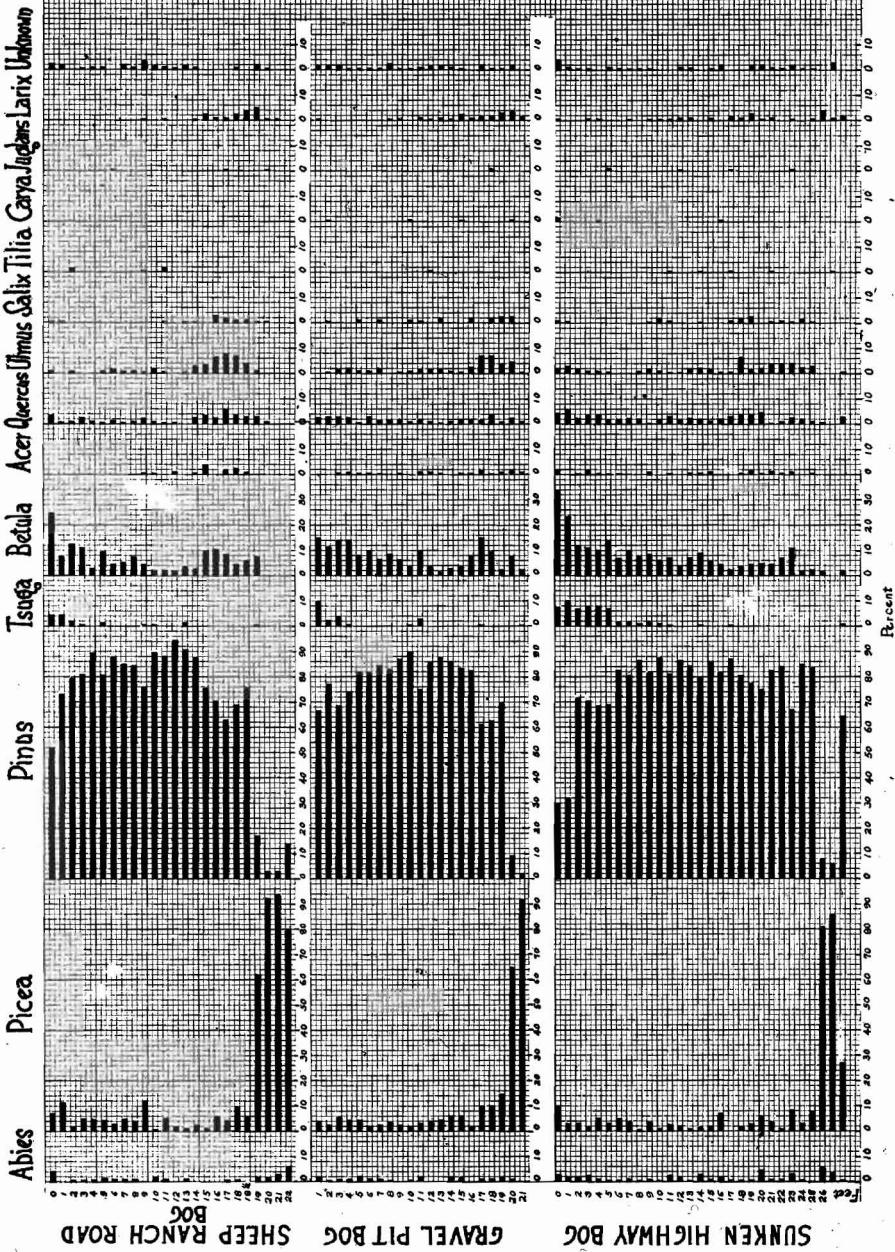
Succession of forests since late Wisconsin glaciation was approximately the same in Price and Sawyer counties as in the Vilas county neighborhood. Except for Sunken Highway bog and Four-mile Lake bog, northern hardwoods (*Betula-Tsuga*) invasion is not very well accentuated. Apparently the locations represented are more of the sandy habitat types which, as Potzger and Richards (10) and Potzger (6) pointed out, are a microclimatic factor which maintains forest cover dominated by *Pinus*. The pollen spectra (figs. 1 and 2) suggest strongly that northern hardwoods invaded later in the locations represented by the five bogs than in the Gillen Nature Reserve (Potzger, 6). *Quercus* indicates no climatic difference in these more westward extending counties than in Vilas county, never exceeding 6% and suggesting no marked warm-dry climatic period. Representation of grass pollen indicates no special climatically favored period for prairie invasion. Its representation increased somewhat in the topmost levels but never exceeded 5% of the total tree pollen. The fact that pollen of *Compositae* rises suddenly in the surface levels, especially in the Sheep Ranch Road bog points to a solidifying mat on which moisture-demanding grasses and composites could invade. Location of boring in the bog and possible omission of several feet of sand are suggested by absence of or limited foot-levels showing *Picea* dominance. The boring in the Four-mile Lake bog had to be made too far from the deepest portion of the basin to include sediments laid down during the *Picea* period. All bogs had sandy bottom layers of which only one foot-level could be obtained with the movable-sleeve type borer, and this very likely resulted in a truncated lower portion of the cores. Such omissions have been shown by Wilson and Potzger (12) in their study of Minnesota lakes, where up to

# DRAPER BOG

# FOUR-MILE LAKE BOG







nine feet of sandy deposits were pollen-bearing. This same feature was discovered by Potzger and Richards (10) in Forestry Bog Lake in Vilas county, Wisconsin, where special effort was made to secure samples from sandy sediments. Pollen of the *Picea* period was embedded in 8 foot-levels of fine sand, which more than doubled the number of foot-levels in other bogs of the area showing *Picea* dominance. If these sandy layers had been omitted, the *Picea* period would have been recorded in only one foot-level. Wilson and Potzger (12) experimented with a new method to secure samples from sandy sediments which worked effectively in Anoka county, Minnesota, and is described in detail in the paper discussing the results of the study.

The "non-conforming" high representation of *Pinus* in the 28-foot level of Sunken Highway bog which yielded to an almost absolute control by *Picea* while the 27- and 26-foot levels were laid down, presents a puzzling problem, which is made more complex by the fact that the 28-foot level was located in sand. Since three of the 5 bogs show a decline of *Pinus* in the second and third lowermost levels (figs. 1 and 2), it may possibly be a microclimatic feature of the region. Potzger and Richards (10) show the same behavior of *Pinus* in the profile from Forestry Bog lake and Cardinal bog. Potzger and Keller (8) found a similar condition in the Mud Creek bog and Bog "E"; Wilson and Webster (14) found a similar condition in the Winchester bog but the initial peaks in *Pinus* representation were not so high as in the Sunken Highway bog.

*Tsuga*, again, very definitely, shows alliance with the broadleaved element. As pointed out by Potzger (6) for Wisconsin, by Wilson and Potzger (13) for northern Michigan and by Potzger and Otto (9) for New Jersey, *Tsuga* apparently always invades with broadleaved genera long after the *Pinus* period had control. The pollen records support the conclusions by Whitford (11) that the hemlock-deciduous species association is the climatic climax for the lake forest.

Wilson and Webster (14) discussed in considerable detail representation of *Carya* and *Juglans* recorded in a pollen profile from a bog near Winchester, Vilas county, Wisconsin. Their arguments very correctly claim that presence of certain genera, even though their pollen frequency is low, may be of important significance in the interpretation of former distribution of such genera as well as in reconstruction of climatic features which made such distribution possible. The author's recent pollen investigations bring considerable additional information on the former distribution of the 2 genera named above,

and for that reason will be discussed in detail here. Potzger (6) reported Juglans from 2 of 4 bogs in the Gillen Nature Reserve (involving northern Vilas county, Wisconsin, and southern Gogebic county, Michigan). Potzger and Richards (10) list Carya and Juglans for 4 of 5 bogs located in the environs of Trout Lake, Vilas county. Potzger and Keller (8) recorded Carya in 5 foot-levels of Bog "E" and Mud Creek bog and 2 foot-levels in Mid Lake bog in Oneida county. Juglans was recorded in 5 levels in Mud Creek bog and in 2 levels in the Mid Lake bog. Juglans also appeared in the topmost 3 foot-levels of Forest Lake bog in Vilas county, approximately 24 miles east of the Winchester bog. Potzger (ms.) found pollen of Carya and Juglans in profiles from 2 bogs in Hubbard county in west-central Minnesota. The range is extended eastward to the lower peninsula in Michigan when Wilson and Potzger (13) reported pollen of Juglans in 4 foot-levels from Middle Fish lake in Montmorency county and at the 85-foot level (total depth 102 feet) of Douglas Lake, Cheboygan county. Carya likewise was recorded in 4 foot-levels in each of the 2 lakes named above. These pollen records extend the former reported range of Carya and Juglans during early post-Pleistocene times westward to western Minnesota, northward to Gogebic county, Michigan and eastward to the upper part of the lower peninsula of Michigan. The recorded distribution in Wisconsin is from the westernmost station in Sawyer county (present study) in an almost unbroken series of locations along highway 70 across Sawyer, Price, Oneida and Vilas counties to the easternmost Forest Lake bog (Vilas county).

We draw attention to the reported presence of *Juglans cinerea* by Potzger (5) in the northern hardwoods near Skull Cave, Mackinac Island, Michigan. This last-named report places *Juglans cinerea* in its present range comparable to the reported post-Pleistocene northward and eastward distribution. It is of course impossible to place the migration of these genera into late postglacial times as Wilson and Webster favor. In Douglas lake these genera appeared already in the 97-foot level (total depth 102 feet). In Gogebic county, Michigan, in the 20-foot level (total depth 22 feet) and in the Cardinal bog at Trout lake, Vilas county, Juglans appeared in the 22-foot level and Carya in the 20-foot level (total depth 22 feet). All these records point to an early invasion, coming at or soon after decline of the *Picea* period.

This writer also cannot share the opinion of Wilson and Webster

(14) that we are "at present experiencing a period of decreasing climatic warmth." So many concrete evidences have been published in recent years which show definitely exactly the opposite of such a conception that one reads such postulations with surprise. Cooper (1) and Griggs (3) have shown that vegetation in Alaska is advancing northward, and glaciers are retreating. Potzger and Friesner (7) pointed out that in all profiles from Indiana bogs, pollen of *Pinus* is present to the topmost levels but aged pioneers of such locations usually assure us that no *Pinus* was present when the country was first being settled. These same authors point out that in Indiana, which is the southernmost rim of that great migration route of boreal and southern species on their northward march, relic boreal species occupy a very precarious position and disappear when their habitat is at all disturbed. Above all, attention should be drawn to the striking reports of the American Geophysical Union which for years have expressed alarm at the rapid retreat of our western mountain glaciers as well as of those in Alaska. Matthes (4) says in his 1942 report, "William O. Field, Jr.'s revisit to Glacier Bay during the summer of 1941 revealed in general widespread diminution of glacier ice since his last visit in 1935. Nearly all the glaciers had receded considerably." For Glacier National Park the report is, "unabated continuance of the rapid wasting of the glaciers in the park." Kincer (15) brings evidence that this moderating climate also involves the central and eastern sections of our country. He says, "There has been a marked tendency to relatively high temperatures since the turn of the century. . . . Southeastern Iowa has twenty days longer frost-free growing season than forty years ago, and the Washington, D. C., winter climate is comparable to that of south-central Virginia of forty years ago." G. S. Callendar (quoted by Kincer) reports the same trend to higher temperatures for Europe.

Considering gross features of the forest succession in the Price-Sawyer county study we must say it was from *Picea* (*Picea-Pinus*) to *Pinus* to northern hardwoods type. During this last period edaphic factors influenced the degree of expression or prevented entirely the establishment of the climatically favored hardwoods. Climate favorable to *Pinus* has persisted longer in these two counties than the other climatic periods combined, being identical in this respect, as well as in the progress of succession, to the Vilas county section.

## SUMMARY

1. Pollen profiles from 5 bogs in Price and Sawyer counties, Wisconsin, are presented. They constitute a section of a line transect along highway 70 westward from the lakes area in Vilas county.

2. The specific aim was to ascertain whether the *Quercus* extension into the southwestern part of Minnesota has, in early post-Pleistocene times, affected a wider area in northern Wisconsin.

3. Succession in forests is essentially the same in Price and Sawyer counties as in Vilas county, which in its gross features was *Picea* (*Picea-Pinus*) to *Pinus* to *Pinus*-northern hardwoods.

4. Apparently the hemlock-northern hardwoods forest is climatic climax in which *Pinus* occupies a post climax position favored by edaphic factors in sandy habitats.

5. *Ulmus* had its highest peak of representation at the time when broadleaved genera invaded the region, and declined towards the closing levels in the bogs.

6. *Quercus* at no time suggests a climate favorable to its expanding development as a vital component in the crown cover of the forests.

7. Grasses give no evidence of a xerothermic climate with extension to prairie into this part of Wisconsin.

8. *Carya* and *Juglans* show a persistent non-aggressive presence in the forest since the close of the *Picea* period. Their distribution is discussed in detail and pollen studies are quoted which show their former range as from west-central Minnesota to Gogebic county, Michigan, eastward to the northern point of the lower peninsula of Michigan; and in Wisconsin from the westernmost Sawyer county in an almost uninterrupted series of bogs to Oneida county and the most eastern location in Forest Lake bog.

## ACKNOWLEDGMENTS

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