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A Comparison of Two Mesic Sand Forests in Mason County, Illinois

David Timothy Coates

Eastern Illinois University

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A COMPARISON OF TWO MESIC SAND FORESTS

IN MASON COUNTY, ILLINOIS

(TITLE)

BY

David Timothy Coates

B.S., Eastern Illinois University, 1987

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1990

YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

20 April 1990

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A COMPARISON OF TWO MESIC SAND FORESTS

IN MASON COUNTY, ILLINOIS

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David Timothy Coates

B.S., Eastern Illinois University, 1987

ABSTRACT OF A THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Science at the Graduate School
of Eastern Illinois University

CHARLESTON, ILLINOIS
1990

ABSTRACT

The present study included surveys of a four hectare
section of Barkhausen Conservation Area and a two hectare
forested section in the Sand Prairie-Scrub Oak Nature
Preserve. This study examines the floristic composition and
structure of these forests, and some of the ecological
parameters that may be responsible for their existence. In
this study, the number, size and species of all living and
dead standing trees (above 10 cm dbh) were recorded for each
quadrat. The relative dominance, relative density,
importance value, average diameter, density in broad
diameter classes and basal area were then calculated for
each species. Nested circular plots were randomly located
in the 25 m x 25 m quadrats in order to obtain seedling and
sapling densities. Seedlings under 40 cm in height,
seedlings over 40 cm in height and sapling were tallied in
nested circular plots of 0.0001, 0.001, and 0.01 ha in size.
Soils were tested for pH and soil texture using the
Bouyoucos Hydrometer Method.

Barkhausen Conservation Area which was dominated by
black oak (IV = 111.2), blackjack oak (IV = 61.5), and
hickory spp. (IV = 22.0); and had a density (trees/ha) of
237.9 with a basal area of 16.3 (m²/ha). A total of 20
woody species were recorded in the woods of which 9 were
canopy trees and 11 were understory trees, shrubs and vines.
These results are also similar to the forest of the Sand
Prairie-Scrub Oak Nature Preserve which were dominated by

black oak (IV = 180.4), blackjack oak (IV = 15.1), and
hickory spp. (IV = 4.2); and had a density (trees/ha) of
394.5 with a basal area of 20.3 (m²/ha). This area
contained 12 woody species of which 5 were canopy species
and 7 were understory trees, shrubs and vines. These closed
forests seem to be fairly stable in composition, since the
relatively shade-intolerant dominant species tend to
reproduce themselves due to the lack of competition in
extremely xeric conditions, and the periodic burns which
keep the canopy open. The fact that black oak and black
hickory have a large number of individuals in the lower
diameter classes, and have sufficient seedling and saplings
for future replacement of veteran trees, tends to support
these findings. Barkhausen Conservation Area and the Sand
Prairie-Scrub Oak Nature Preserve are typical examples of
closed forest associated with sand dunes of the Illinois
River Sand Area Section.

To my parents, Mr. and Mrs. Ralph H. Coates Jr.

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INTRODUCTION

In 1910, Gleason studied the inland sand deposits in
Illinois. This study included a description of natural
phenomena, a chapter on origins of plants, an annotated list
of the vascular plants, and a detailed classification of
plant associations. In the chapter on black oak
associations, he listed two types of tree species typically
associated with black oaks. They are blackjack oak and
hickory spp. Later, Maier (1976) presented an annotated
list of the vascular plants of Sand Ridge Forest in Mason
County, Illinois (Figure 1). He identified the vascular
plants, defined their habitats, assessed their abundance,
and recorded their flowering times. He found that many of
the floral elements, both species and associations,
described by Gleason (1910) were either absent or scarce at
Sand Ridge State Forest. He suggested a lowered water table
and man's activities as possible explanations for these
observations.

Prominent examples of recent disturbances include clear
cutting of forest, cultivation of the land, and planting of
pines and other exotics which grow well on sand. Maier
(1976) also stated that numerous plantings and fencerows
have decreased the amount of wind-blown sand, which altered
the delicately balanced successional processes. Later,
Rodgers and Anderson (1979) studied the presettlement
vegetation of McLean and Mason Counties. Using General Land
Office survey records, they determined presettlement

vegetation by modification of the distance methods (Cottam and Curtis 1956) to compute density, frequency, dominance (basal area), and importance value (IV) of taxa recorded as witness trees. They concluded that closed forests associated with sands of this area were dominated by black oak (IV = 118.31), blackjack oak (IV = 18.35), and hickory spp. (IV = 21.81).

Other studies conducted in the Sand Prairie-Scrub Oak Nature Preserve by Anderson and Brown (1983, 1986), determined the effect of fire on trees in a midwestern savannah and an adjacent forest. Anderson and Brown (1986) concluded that fire may have either a stabilizing or destabilizing influence, depending on the vegetation present in the area. Fire stabilizes open forests, prairies, and savannahs but tends to destabilize closed forest systems. It appears that fewer natural burns as a result of man's ability to control fire, have made closed forest systems more common. The most recent study conducted on an Illinois sand forest was by Jenkins (1989), who determined the species composition and structure of a closed sand forest in Mason County, Illinois. He found black oak (IV = 144.9), black hickory (IV = 22.6), and a blackjack oak (IV = 15.0) to be the most common species present, and concluded that most of the overstory species were relatively evenly distributed throughout the woods. The exception was blackjack oak which exhibited a clumped distribution, being limited to the margins of small clearings.

The present study included surveys of a four hectare section of Barkhausen Conservation Area and a two hectare forested section in the Sand Prairie-Scrub Oak Nature Preserve. This study examines the floristic composition and structure of these forests, and some of the ecological parameters that may be responsible for their existence.

MATERIALS AND METHODS

During the summer of 1989, surveys of a four ha section of Barkhausen Conservation Area and a two ha section of Sand Prairie-Scrub Oak Nature Preserve were conducted. Each study site was divided into 25 m x 25 m quadrats (0.154 acres). The number, size and species of all living and dead standing trees (above 10 cm dbh) were recorded for each quadrat. The relative dominance, relative density and importance value (IV) were then calculated for each species encountered. The procedure for IV determination follows that developed by McIntosh (1957) and later by Boggess (1964), and is the sum of the relative density and relative dominance. The average diameter (cm), density (#/ha) in broad diameter classes, and basal area (m²/ha) were also calculated for each species.

Nested circular plots of 0.0001, 0.001, and 0.01 ha in size were randomly located in each of the 25 m x 25 m quadrats. Seedlings under 40 cm in height were tallied the on 0.0001 ha plot, seedlings more than 40 cm in height but less than 2.5 cm dbh were recorded in the 0.001 ha plot, and

saplings (2.5-10.0 cm dbh) were recorded in the 0.01 ha plot and their densities (#/ha) determined. Nomenclature follows Mohlenbrock (1986).

Soil pits were randomly located within both study areas in order to determine the depth of the A horizon and to determine pH and soil texture of both A and B horizons. The soil pH was measured using a Corning pH meter (Model 7). Extra pH readings were taken in the Barkhausen Conservation Area in order to assure consistency throughout the area. The soil texture was determined using the Bouyoucos Hydrometer Method (Bouyoucos 1962). Data from the two study areas were placed into tables and compared using a Chi Square test (Zar 1984).

RESULTS AND DISCUSSION

Barkhausen Conservation Area

Barkhausen Woods which is 45 acres (20.5 ha) in size is located approximately 8 miles northeast of Chandlerville in Mason County, Illinois (NW1/4, Sec. 19, T19N, R10W). The woods is relatively flat varying in elevation from 453 ft. to 480 ft., with almost no relief except for the present of a stabilized sand dune at the southern margin which rises to about 6 m above the remainder of the area. The soils are sandy and were developed from deep sand deposits laid down by glacial melt waters (Willman and Frye 1970; Schwegman 1973; Maier 1976). This oak-hickory forest, dominated by Quercus velutina (black Oak), Carya texana (black hickory)

and <u>Quercus</u> <u>marilandica</u> (blackjack oak), was probably more open in the past, but presently shows no sign of logging or grazing. It was donated to the Illinois Department of Conservation in the early 1960's and is now called Barkhausen Conservation Area.

A total of 20 woody species were recorded in the woods of which 9 were canopy trees and 11 were understory trees, shrubs and vines. The tree species encountered, along with their densities in broad diameter classes and basal area per ha, relative values, importance values, and average diameters are listed in Table 1, while the understory shrubs and vines, along with their densities (#/ha) appear in Table 2.

The overstory species <u>Quercus</u> <u>velutina</u> (black oak) ranks first in IV (111.2) having the highest relative dominance (76.7), and the second highest relative density (34.5). It is common in all diameter classes, but 62% of the individuals exceed 40 cm dbh, and it has the highest average diameter (41.3 cm dbh). This species also accounts for 77% of the total basal area in the woodlot, ranks first in the seedlings/ha, and second in saplings/ha (Table 1).

<u>Carya</u> <u>texana</u> (black hickory) ranks second with an IV of 61.5, having the highest relative density, and the second highest relative dominance (Table 1). It is common in the lower diameter classes, with 81% of the individuals in the 10-20 cm class, and has an average diameter of 15.9 cm dbh. Of the overstory species, it ranks third in seedlings/ha and

first in saplings/ha, accounting for 64% of the saplings encountered.

Quercus marilandica (blackjack oak) ranks third with an IV of 22.0, being third in both relative dominance and relative density (Table 1). It is relatively common in the lower diameter classes and has an average diameter of 19.1 cm dbh. It ranks second in seedlings/ha, but very few saplings are encountered.

The other canopy species encountered are of minor importance, accounting for a combined IV of 5.3. Most are found in the seedling, sapling, and 10-20 cm diameter class. Of these species Catalpa speciosa (catalpa) is the most common, followed by Prunus serotina (wild black cherry) and Gleditsia tricanthos (honey locust). Most of these species are found in areas where past-trees falls have created canopy openings.

Multiple stemmed trees (coppice) are relatively common in Barkhausen Conservation Area, averaging 15.3 coppice trees/ha, with an average of 35.3 stems/ha, and a basal area of 2.0 m²/ha. Blackjack oak accounts for 41% of the coppice growth and 23% of the total coppice basal area with an average dbh per stem of 18.8 cm. It is the most numerous of the five coppice species with an average of 6.3 trees/ha and 2.5 stems/tree. Black oak accounts for 26% of the coppice growth but makes up 65% basal area with the average stem being 42.5 cm dbh. Black hickory accounts for 30% of the coppice growth but only accounted for 11% of the total basal

area because of its small average dbh (16.4 cm). Other species exhibiting coppice growth are <u>Sassafras albidum</u> (sassafras) and <u>Tilia americana</u> (linden).

Tree mortality in Barkhausen Conservation Area averages 26.8 dead standing trees/ha, with an average diameter of 33.6 cm dbh and a basal area of 2.7 m²/ha. Black oak has the highest mortality with 18.5 dead trees/ha, and an average diameter of 39.3 cm dbh. As expected, this species accounts for 69% of the dead trees, and 89% of the dead tree basal area. Blackjack oak ranks second in mortality with 5.8 stems/ha, and an average stem size of 20.7 cm dbh, while black hickory accounts for 9% of the dead trees, with an average stem size of 20.9 cm dbh.

Nine shrubs were encountered in the understory with <u>Toxicodendron radicans</u> (poison ivy), <u>Rubus allegheniensis</u> (blackberry) and <u>Cornus racemosa</u> (gray dogwood) accounting for 84% of the total number of stems (Table 2). These species are most common in open areas of the woods, and are usually clumped. Of all shrub species, poison ivy dominates, occurring also under dense understory, as does gray dogwood.

The soils in Barkhausen Conservation Area are extremely sandy and acidic (Table 3). The A horizon throughout the area has an average depth of 7.8 cm and an average pH of 4.9, while the B horizon has an average pH of 4.6. The A horizon has an average soil texture of 89.5% sand, 8.1% silt, and 2.4% clay, while the B horizon has an average soil

texture of 92.5% sand, 5.4% silt, and 2.1% clay.

Sand Prairie-Scrub Oak Nature Preserve

Sand Prairie-Scrub Oak Nature Preserve, 1461 acres (664 ha) in size, is located approximately 3.5 miles southeast of Bath in Mason County, Illinois (NW1/4 Sec. 13, Sec. 14, Sec. 23, N1/2 Sec. 26, T20N, R9W). The Sand Prairie-Scrub Oak Nature Preserve is relatively flat, varying in elevation from 500 ft. to 520 ft.. The soils are sandy and were developed from deep sand deposits laid down by glacial melt waters (Willman and Frye 1970; Schwegman 1973; Maier 1976; Anderson and Brown 1983). The Sand Prairie-Scrub Oak Nature Preserve contains many vegetation types, but this study concentrated on the oak-hickory forest which is dominated by Quercus velutina (black Oak), Quercus marilandica (blackjack oak), and Carya texana (black hickory) located in the southeastern part of the preserve (NE1/4 Sec. 26, T20N, R9W). In the early part of this century, the area was used for farming and grazing before it was dedicated as an Illinois Nature Preserve to retain the natural features which include extensive sand prairies, savannahs, and blowouts. In the past the forests of the Sand Prairie-Scrub Oak Nature Preserve were most likely subjected to logging and periodic fires.

A total of 12 woody species was recorded in the woods of which 5 were canopy trees and 7 were understory trees, shrubs and vines. The tree species encountered, along with

their densities in broad diameter classes and basal area/ha, relative values, importance values, and average diameters are listed in Table 1, while the understory shrubs and vines, along with their densities (#/ha) appear in Table 2.

The overstory species Quercus velutina (black oak) ranks first in IV (180.4) having the highest relative density (85.9) and relative dominance (94.5). It is common in all diameter classes with 83% of the individuals exceeding 20 cm dbh, and it has the highest average diameter (26.0 cm dbh). This species also accounts for 94% of the total basal area in the woodlot and ranks first in seedlings/ha and saplings/ha (Table 1).

Quercus marilandica (blackjack oak) ranks second with an IV of 15.1, ranking second in both relative dominance and relative density (Table 1). It is common in the lower diameter class with 82% of the individuals in the 10-20 cm class and with an average diameter of 16.6 cm dbh. This species ranks third in number of seedlings/ha and has very few saplings.

Carya texana (black hickory) ranks third with an IV of 4.2. It is represented in the two lower diameter classes with 96% of the individuals less than 20 cm dbh and having an average diameter of 13.3 cm dbh. This species ranks second in the number of seedlings/ha and has the highest number of saplings/ha.

The three remaining tree species are of minor importance, accounting for an IV of 0.3. Of these species,

only Prunus serotina (wild black cherry) reaches tree size.
This species is only found in the 10-20 cm diameter class
with an average diameter of 10.7 cm dbh. Only a few
seedlings and saplings of these species were encountered.

Coppice growth is common in this woodlot, averaging 84
coppice trees/ha, with an average of 191 stems/ha, and a
basal area of 10.3 m²/ha. Quercus velutina (black oak)
accounts for 90% of the coppice growth and makes up 96.1% of
the coppice basal area with an average stem having a 26.3 cm
dbh, averaging 76 trees/ha and 2.3 stems/tree. Quercus
marilandica (blackjack oak) accounts for 8% of the coppice
growth and 3.7% of the coppice basal area with an average
diameter of 17.0 cm dbh. Other species with coppice stems
are Carya texana (black hickory) and Prunus serotina (wild
black cherry).

Tree mortality in this woods averages 59 dead standing
trees/ha, with an average diameter of 16.2 cm dbh and a dead
basal area of 1.3 m²/ha. Black oak has the highest
mortality with 48 dead trees/ha, averaging 16.4 cm dbh.
Black oak species accounts for 81.4% of the dead trees, and
83.8% of the dead tree basal area, while blackjack oak ranks
second in mortality with 10.5 stem/ha, and an average stem
size of 15.5 cm dbh. Black hickory accounts for only 0.8%
of the dead trees.

Six shrubs were encountered in the understory (Table
2). Ceanothus americanus (New Jersey tea) is the most
common, accounting for 40.6% of the total number of stems

followed by <u>Rubus</u> <u>occidentalis</u> (red raspberry) with 36.6%
and <u>Toxicodendron</u> <u>radicans</u> (poison ivy) which accounted for
9.9% of the stems.

The soil in the Sand Prairie-Scrub Oak Nature Preserve
is extremely sandy and acidic (Table 4). The A horizon
throughout the area has an average depth of 8.0 cm, an
average pH of 3.4 and an average soil texture of 93.1% sand,
4% silt, and 2.9% clay. The B horizon has an average pH of
3.3 and an average soil texture of 94.7% sand, 2.8% silt,
and 2.5% clay.

The results from the two areas were compared using a
Chi Square test (Zar 1984). The tests were used to
determine if there were significant differences between the
species regarding density (#/ha) of the dead trees, coppice
growth and size distribution and densities (#/ha) of three
main live tree species found in both areas. The Chi Square
statistical procedures which were used include: 1). 2 x 2
contingency table, $X^2_{0.05,1}$ = 3.841 with a 95% confidence
limit, 1 degree of freedom; 2). 2 x 3 contingency table, $X^2_{0.05,2}$ = 5.991 with a 95% confidence limit, 2 degrees of
freedom; 3). 2 x 5 contingency table, $X^2_{0.05,4}$ = 9.488 with
a 95% confidence limit, 4 degrees of freedom; or 4). 2 x 6
contingency table, $X^2_{0.05,5}$ = 11.071 with a 95% confidence
limit, 5 degrees of freedom. The Chi Square tests showed
similarities in the size and #/ha of blackjack oak ($X^2_{0.05,1}$ = 3.6) and the composition of dead/ha ($X^2_{0.05,2}$ =
4.44) among the black oak, black hickory and blackjack oak.

The Chi Square tests showed statistically significant differences in the size and the #/ha of black oak (X^2 $_{0.05,5}$ = 204.5) and black hickory (X^2 $_{0.05,1}$ = 4.21) and that there is no correlation between the coppice growth (X^2 $_{0.05,2}$ = 37.3).

The present results tend to indicate that these two forests are typical examples of closed forests associated with the sand dunes of the Illinois River Sand Area Section. In a study of the presettlement vegetation of McLean and Mason County, Rodgers and Anderson (1979) concluded that the closed forests associated with the sand dunes in Mason County were dominated by black oak (IV = 118.31), blackjack oak (IV = 18.35), and hickory spp. (IV = 21.81); and have a density (trees/ha) of 263.29 with a basal area of 29.28 (m^2/ha). Their results resemble those found in the present study of Barkhausen Conservation Area which was dominated by black oak (IV = 111.2), blackjack oak (IV = 61.5), and hickory spp. (IV = 22.0); and had a density (trees/ha) of 237.9 with a basal area of 16.3 (m^2/ha). These results are also similar to the forests of the Sand Prairie-Scrub Oak Nature Preserve which were dominated by black oak (IV = 180.4), blackjack oak (IV = 15.1), and hickory spp. (IV = 4.2); and had a density (trees/ha) of 394.5 with a basal area of 20.3 (m^2/ha). They also suggested that these closed forests seem to be fairly stable in composition, since the relatively shade-intolerant dominant species tend to reproduce themselves due to the lack of competition in

extremely xeric conditions, and the periodic burns which keep the canopy open. The fact that black oak and black hickory have a large number of individuals in the lower diameter classes, and have sufficient seedling and saplings for future replacement of veteran trees, tends to support these findings.

In another study comparing the effects of fire on trees in a midwestern savannah and an adjacent forest, Anderson and Brown (1983) found that savannahs in the midwest and elsewhere often owe their subtainment to periodic fires (Blydenstein 1967; Hills and Randall 1968; Anderson and Fralish 1975; Henderson and Long 1984). They also stated that this acceptance is based on two lines of evidence: 1). in the absence of burning, savannahs are rapidly converted to closed forests (Cottam 1949; Curtis 1959; Muir 1965), and 2). in many forests in the midwest there are widely spaced, large, open-grown trees that are surrounded by smaller, forest-grown trees. Anderson and Brown (1983) also stated that it was obvious that many of these closed forests originated from savannahs when periodic fires were stopped as Europeans settled the region (Cottam 1949; Curtis 1959; Anderson and Adams 1978; Rodgers and Anderson 1979; Anderson 1982). Anderson and Brown (1986), comparing past studies (Rodgers and Anderson 1979; Anderson 1982) with current findings, demonstrate that fire can act as a stabilizing or destabilizing influence depending upon the nature of the vegetation, encouraging development of open forest,

savannah, and grasslands but not closed forest systems.
Their work supports the conclusions of Abrahamson (1984a,b)
who indicated that with some vegetational fire types there
is a "normal environmental feature" that does not initiate
succession in the classical sense. Instead it may act as a
destablizing factor depending upon the frequency of burning
and the nature of the vegetation.

In a more recent study of a woody vegetation survey of
a sand forest in Mason County, Illinois by Jenkins (1989),
Chi Square tests were used to find correlations between the
current study and Jenkins's study. The tests showed
similarities with the Barkhausen Conservation Area in terms
of size and the #/ha of black hickory ($X^2\ _{0.05,1}=$ .104), in
blackjack oak ($X^2\ _{0.05,1}=$ .19), and in the composition of
dead/ha ($X^2\ _{0.05,1}=$ .91) among the black oak, black hickory
and blackjack oak. The Chi Square test also showed
statistically significant differences in the size and the
#/ha of black oak ($X^2\ _{0.05,4}=$ 38.4) but there was not enough
data to show any correlation between the coppice growth of
these two areas. The tests showed similarities with the
Sand Prairie-Scrub Oak Nature Preserve forest in size and
the #/ha of black hickory ($X^2\ _{0.05,1}=$ 2.1) and in the
composition of dead/ha ($X^2\ _{0.05,1}=$ .31) and in coppice/ha
($X^2\ _{0.05,1}=$ .242) among the black oak, black hickory and
blackjack oak. The Chi Square test also showed
statistically significant differences in the size and #/ha
of black oak ($X^2\ _{0.05,4}=$ 68.15) and blackjack oak (X^2

0.05,1 = 4.57).

Another area which showed a great difference between the two areas, was in the average diameter of the live individuals (Table 1). Quercus velutina (black oak) had an average 41.3 cm dbh in the Barkhausen Conservation Area as compared to the average of 26.0 cm dbh in the Sand Prairie-Scrub Oak Nature Preserve. Carya texana (black hickory) had an average 15.9 cm dbh in the Barkhausen Conservation Area as compared to the average of 13.3 cm dbh in the Sand Prairie-Scrub Oak Nature Preserve. Quercus marilandica (blackjack oak) had an average 19.1 cm dbh in the Barkhausen Conservation Area as compared to the average of 16.6 cm dbh in the Sand Prairie-Scrub Oak Nature Preserve.

In comparing tree mortality between the two areas, Barkhausen Conservation Area averaged 26.8 dead trees/ha, with an average diameter of 33.6 cm dbh and a basal area of 2.7 m²/ha while in the Sand Prairie-Scrub Oak Nature Preserve averaged 59 dead trees/ha, with an average diameter of 16.2 cm dbh and a basal area of 1.3 m²/ha. Comparing the average diameter of dead individuals showed a great difference among the two areas. Quercus velutina (black oak) had an average 39.3 cm dbh in the Barkhausen Conservation Area as compared to the average of 16.4 cm dbh in the Sand Prairie-Scrub Oak Nature Preserve. Carya texana (black hickory) had an average 20.9 cm dbh in the Barkhausen Conservation Area as compared to the average of 10.5 cm dbh in the Sand Prairie-Scrub Oak Nature Preserve. Quercus

marilandica (blackjack oak) had an average 20.7 cm dbh in
the Barkhausen Conservation Area as compared to the average
of 15.5 cm dbh in the Sand Prairie-Scrub Oak Nature
Preserve.

In comparing coppice growth between the two areas,
Barkhausen Conservation Area averaged 15.3 coppice trees/ha,
with an average of 35.3 stems/ha and a basal area of 2.0
m²/ha while the Sand Prairie-Scrub Oak Nature Preserve
averaged 84 coppice trees/ha, with an average of 191
stems/ha and a basal area of 10.3 m²/ha which means both
areas have an average of 2.3 stems/tree. In comparing the
two areas, a great difference was shown in the average
diameter of the coppice individuals. Quercus velutina
(black oak) had an average 42.5 cm dbh in the Barkhausen
Conservation Area as compared to the average of 26.3 cm dbh
in the Sand Prairie-Scrub Oak Nature Preserve. Carya texana
(black hickory) had an average 16.4 cm dbh in the Barkhausen
Conservation Area as compared to the average of 10.6 cm dbh
in the Sand Prairie-Scrub Oak Nature Preserve. Quercus
marilandica (blackjack oak) had an average 18.8 cm dbh in
the Barkhausen Conservation Area as compared to the average
of 17.0 cm dbh in the Sand Prairie-Scrub Oak Nature
Preserve.

A Chi Square analysis was also used to determine if
there were correlations between the shrub and vine densities
but none were found. Similar results were found by Gleason
(1910) who observed that in each of the extralimital

localities the dominant tree is the black oak, while the herbaceous vegetation showed considerable variation. This is because of the differences in the neighboring associations, from which many species find their way into the black oak forest. Warming (1909) has termed such conditions as "geographical variations" of an association.

The soils of both woods are very similar (Tables 3 and 4). The average depth of the A horizon is almost identical (7.8 cm - 8.0 cm) as is the texture of the A Horizon. The average pH of both the A and B horizons in the Sand Prairie-Scrub Oak Nature Preserve was lower as compared to that of Barkhausen Conservation Area (Tables 3 and 4). The soil texture test showed that the preserve had a higher percentage of sand in both the A and B horizons than those of Barkhausen Conservation Area. The A and B horizons of the Barkhausen Conservation Area had the highest average percent of silt (8.1% and 5.4% respectively). The average percent of clay was about the same for A and B horizons in both areas. Baier *et al.* (1972) found that the soils of the sand prairies at Sand Prairie Scrub-Oak Nature Preserve have lower pH's in both the A and B horizons than those of this study. One reason for the difference could be that their study was conducted in a sand prairie as compared to this study which was conducted in a sand forest.

In a more recent and similar study by Jenkins (1989), it is stated that the average soil texture of the A horizon was 88.8% sand, 3.3% silt and 7.9% clay, while the B horizon

had an average soil texture of 91.1% sand, 2.1% silt and
6.8% clay. These results are similar to Barkhausen
Conservation Area and remotely similar to the Sand Prairie-
Scrub Oak Nature Preserve. Adams and Anderson (1980)
reported that sites in the sand areas along the Illinois
River have soils that varied in texture from 92-100% sand.

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Table 1. Densities (#/ha), diameter classes, basal areas (m²/ha), relative values, importance values and average
diameters of the woody species in two mesic sand forest located in Mason County, Illinois.

Species	Seedlings #/ha		Sap-lings #/ha	Diameter Classes(cm) #/ha						Total	Basal Area	Rel. Den.	Rel. Dom.	I.V.	Av. Diam. (cm)
	<40cm	>40cm		10-20	20-30	30-40	40-50	50-60	60+						
Barkhausen Conservation Area, Mason, Co. IL. (NW1/4, Sec. 19, T19N, R10W)															
Quercus velutina Lam.	2500	859	139	11.3	7.3	12.8	25.8	17.0	8.0	82.2	12.5	34.5	76.7	111.2	41.3
Carya texana Buckl.	1406	844	564	89.3	16.5	3.0	0.8	--	--	109.6	2.5	46.2	15.3	61.5	15.9
Quercus marilandica Muenchh.	2188	609	20	22.3	10.8	1.5	1.0	--	--	35.6	1.2	14.9	7.1	22.0	19.1
Others*	1096	797	153	10.0	0.5	--	--	--	--	10.5	0.1	4.4	0.9	5.3	--
Totals	7188	3109	876	132.9	35.1	17.3	27.6	17.0	8.0	237.9	16.3	100.0	100.0	200.0	
Sand Prairie-Scrub Oak Nature Preserve, Mason, Co. IL. (NW1/4 Sec. 13, Sec. 14, Sec. 23, N1/2 Sec. 26, T20N, R9W)															
Quercus velutina Lam.	5938	219	16	59.0	193.5	79.0	5.0˘	1.5	1.0	339.0	19.2	85.9	94.5	180.4	26.0
Quercus marilandica Muenchh.	313	--	3	34.0	7.5	--	--	--	--	41.5	0.9	10.5	4.6	15.1	16.6
Carya texana Buckl.	625	406	44	12.5	0.5	--	--	--	--	13.0	0.2	3.3	0.9	4.2	13.3
Prunus serotina Ehrh.	--	31	3	1.0	--	--	--	--	--	1.0	--	0.3	--	0.3	10.7
Others**	--	63	3	--	--	--	--	--	--	--	--	--	--	--	--
Totals	6876	719	69	106.5	201.5	79.0	5.0	1.5	1.0	394.5	20.3	100.0	100.0	200.0	

* Includes

Represented by trees, seedlings and saplings (exception = +) Catalpa speciosa (Warder) Englem., Sassafras albidum
(Nutt.) Nees., Diospyros virginiana L., Ulmus americana L., +Tilia americana L., Celtis occidentalis L., Morus rubra
L., and +Amelanchier arborea (Michx. f.) Fern.

Represented by seedling and sapling exclusively Prunus serotina Ehrh., Gleditsia triacanthos L., Juniperus virginiana
L., Ulmus rubra Muhl., Fraxinus americana L. and Betula nigra L.

** Includes Sassafras albidum (Nutt.) Nees. and Juniperus virginiana L.

Table 2.   Density (#/ha) of the shrub species encountered in
           two mesic sand forests located in Mason County,
           Illinois.

SPECIES	Barkhausen Conservation Area INDIVIDUALS/HA (64 plots)	Sand Prairie-Scrub Oak Nature Preserve INDIVIDUALS/HA (32 plots)
Toxicodendron radicans (L.) Kuntze.	4438	313
Rubus allegheniensis Porter	2125	281
Cornus racemosa Lam.	1203	--
Ribes missouriense Nutt.	765	94
Rhus aromatica Ait.	328	--
Zanthoxylum americanum Mill.	172	--
Rubus occidentalis L.	172	1156
Elaeagnus umbellata Thunb.	16	--
Ceanothus americanus L.	16	1281
Rhus glabra L.	--	31
Totals	9235	3156

Table 3.   Soil texture, depth of A the horizon from four
soil pits, and pH of the A and B horizons from
fourteen soil pits in Barkhausen Conservation Area
located near Chandlerville, Mason County,
Illinois.

Sample	A HORIZON Depth (cm)	A HORIZON pH	A HORIZON Soil Texture	B HORIZON pH	B HORIZON Soil Texture
1 A2	7.0	5.4	94.5% sand	4.5	95.5% sand
			3.5% silt		2.5% silt
			2.0% clay		2.0% clay
2 D3	8.0	4.9	86.5% sand	4.6	90.0% sand
			11.0% silt		8.0% silt
			2.5% clay		2.0% clay
3 H2	8.0	4.8	87.0% sand	4.3	90.5% sand
			11.0% silt		7.0% silt
			2.0% clay		2.5% clay
4 L3	8.0	4.3	90.0% sand	4.3	94.0% sand
			7.0% silt		4.0% silt
			3.0% clay		2.0% clay

RANDOM QUADRATS

Sample		pH		pH	
1		4.6		4.9	
2		3.9		4.3	
3		4.9		4.8	
4		5.3		4.8	
5		5.0		4.5	
6		5.1		4.3	
7		5.6		5.4	
* 8		4.7		4.5	* = BLACKJACK OAK
* 9		5.5		4.6	AREA
*10		4.5		4.2	

| average | 7.8 | 4.9 | | 4.6 | |

Table 4. Soil texture, depth of A the horizon, and pH of
the A and B horizons from five soil pits in the
Sand Prairie-Scrub Oak Nature Preserve located
near Bath, Mason County, Illinois.

| Sample | A HORIZON | | | B HORIZON | |
	Depth (cm)	pH	Soil Texture	pH	Soil Texture
1 A1	8.0	3.4	92.5% sand	3.3	95.5% sand
			4.0% silt		2.0% silt
			3.5% clay		2.5% clay
2 A2	8.0	3.1	94.0% sand	3.3	94.5% sand
			3.5% silt		2.0% silt
			2.5% clay		3.5% clay
3 A3	8.0	3.5	94.5% sand	3.3	93.5% sand
			3.5% silt		4.0% silt
			2.0% clay		2.5% clay
4 A4	8.5	3.8	92.5% sand	3.4	94.5% sand
			3.5% silt		3.5% silt
			4.0% clay		2.0% clay
5 A5	7.5	3.3	92.0% sand	3.4	95.5% sand
			5.5% silt		2.5% silt
			2.5% clay		2.0% clay
average	8.0	3.4		3.3	

A. ROCK RIVER
B. GREEN RIVER
C. FOX RIVER
D. DES PLAINES RIVER
E. KANKAKEE RIVER
F. VERMILION RIVER
G. SANGAMON RIVER
H. ILLINOIS RIVER
I. MISSISSIPPI RIVER
J. KASKASKIA RIVER
K. EMBARRASS RIVER
L. WABASH RIVER
M. LITTLE WABASH RIVER
N. BIG MUDDY RIVER
O. CACHE RIVER
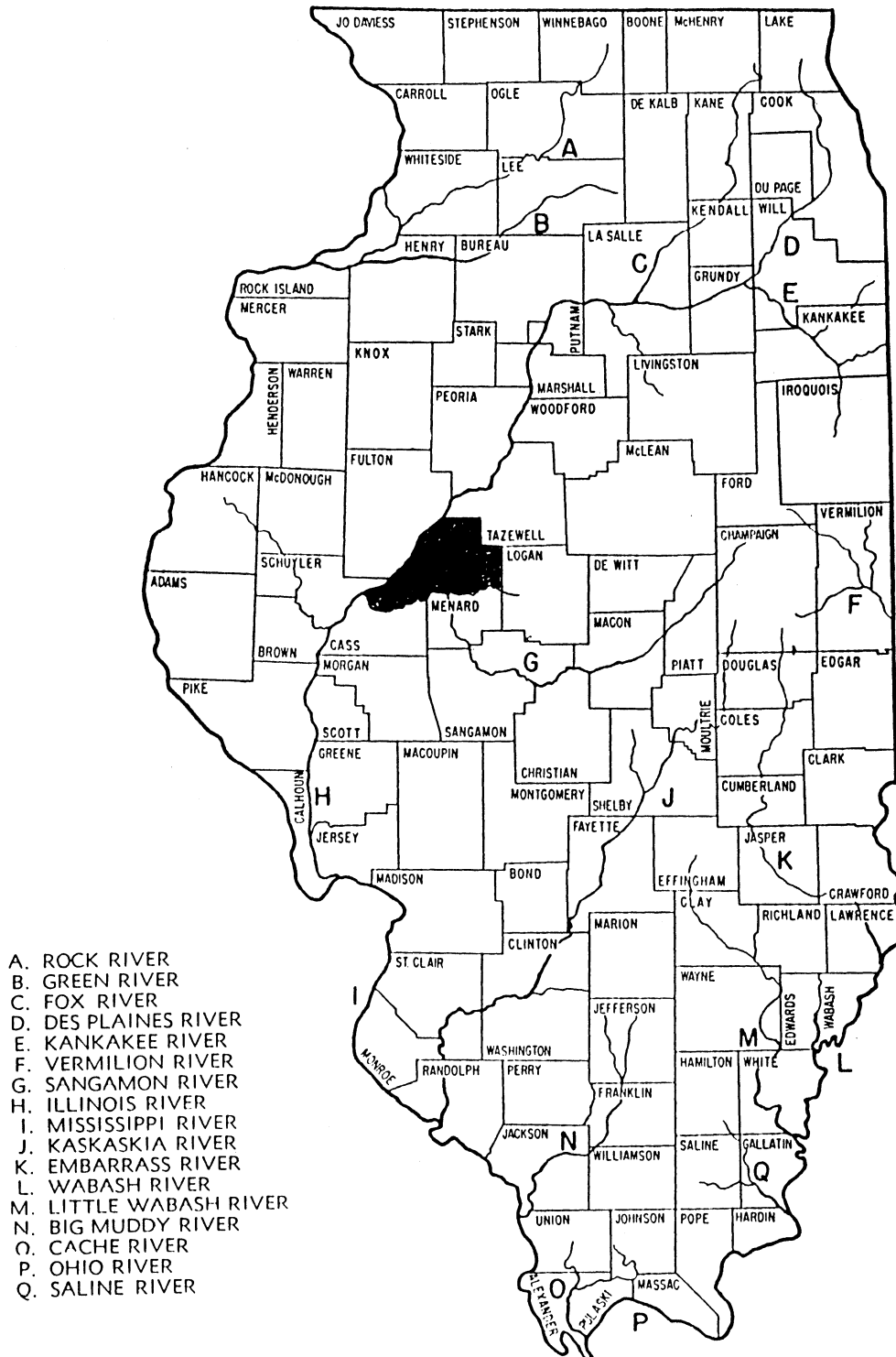P. OHIO RIVER
Q. SALINE RIVER

Figure 1. Map of Illinois showing counties and major rivers. The shaded area represents Mason County, Illinois.