

A Comparison of Post Oak-Blackjack Oak Communities on Two Major Soil Types in North Central Oklahoma

Don D. Dwyer and
Paul W. Santelmann



Bulletin B-626
August 1964

CONTENTS

| | |
|-------------------------------------|----|
| Description of the Study Area | 6 |
| Soils | 6 |
| Darnell Fine Sandy Loam | 6 |
| Stephenville Fine Sandy Loam | 7 |
| Methods and Procedures | 7 |
| Results and Discussion | 8 |
| Species Composition | 8 |
| Overstory Vegetation | 8 |
| Understory Vegetation | 9 |
| Diameter and Height | 11 |
| Annual Ring Counts | 12 |
| Summary | 13 |
| Literature Cited | 14 |

A Comparison of Post Oak-Blackjack Oak Communities on Two Major Soil Types in North Central Oklahoma

Don D. Dwyer and Paul W. Santelmann

An estimated 6.2 million acres of cross timbers in Oklahoma extends through the east central portion of the state from the Kansas line to Texas (Gray and Galloway, 1959). The cross timbers area is situated on rolling to hilly sandstone uplands and is dominated by post oak (*Quercus stellata*) and blackjack oak. (*Q. marilandica*) (Figure 1.)

The main objective of this study was to determine the influence of soil type on the vegetative cover of post oak-blackjack oak communities. Darnell and Stephenville soil series were studied because of their close association and common occurrence in the cross timbers region of Oklahoma.

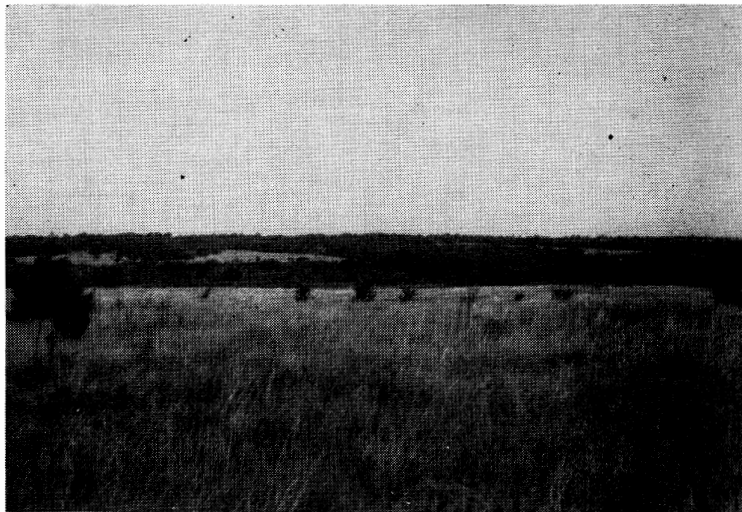


Fig. 1. Cross timbers area of north central Oklahoma where post oak is the major dominant. Grassland openings dominated by little bluestem are common.

Research reported herein was done under Oklahoma Agricultural Experiment Station project 1146.

The soils of the cross timbers are moderately leached and of the Red-Yellow podzolic zone (Gray and Galloway, 1959). Considerable increase in oak density has occurred on these lands in the past half century, particularly on the moderate to very shallow depth soils.

Bruner (1931) described the cross timbers area of Oklahoma as a forest poor in species and dwarfed in stature, commonly associated with grassland. Dyksterhuis (1948) conducted one of the most comprehensive studies of the cross timbers in Texas. His study showed post oak to be the dominant species, usually making up 63 percent with blackjack contributing 29 percent to the woody composition.

DESCRIPTION OF THE STUDY AREA

Four sites were studied in the Lake Carl Blackwell area west of Stillwater, Oklahoma. Two sites were on Darnell soil and two on Stephenville soil. Past treatment of the areas had been moderate winter grazing but no summer grazing since the lake was established in 1936. History of the area prior to 1936 is unknown. The areas studied were never cleared but some of the trees may have been cut by homesteaders for fence posts or fire wood.

Soils

A typical profile of each of the two soil types investigated is described below. These descriptions were taken from Soil Conservation Service mimeo (1961). Color names are based on Munsell color charts.

Darnell Fine Sandy Loam

| Depth | Description |
|----------------------|---|
| A ₁ 0-5" | Grayish-brown fine sandy loam; very weakly granular; very friable; slightly acid; grades to horizon below. |
| A ₂ 5-12" | Light-brown light fine sandy loam; structureless; very friable moist; nearly loose when dry; contains fragments of sandstone in its lower part. |
| C | Yellowish-red noncalcareous sandstone. |

Drainage is rapid from the surface and internally. The usual depth ranges from shallow to very shallow.

Stephenville Fine Sandy Loam

| Depth | Description |
|-------------------------|--|
| A ₁ 0-5" | Brown (7.5YR 4/2; dark brown, 7.5YR 3/2, moist) fine sandy loam; weak fine granular; very friable; slightly acid; grades into horizon below. |
| A ₂ 5-15" | Light-brown (7.5YR 6/3 brown, 7.5YR 4/3, moist) fine sandy loam; massive, porous; very friable; slightly acid; grades into horizon below. |
| B ₂₋₁ 15-25" | Yellowish-red (5YR 4/6; 4/8, moist) sandy clay loam; weak medium blocky; friable; plastic when wet; very hard when dry; slightly acid; grades into horizon below. |
| B ₂₋₂ 25-36" | Yellowish-red (5YR 5/6; 4/8, moist) light sandy clay loam somewhat more sandy than horizon above; massive to weak medium blocky; very friable; hard when dry; slightly acid; grades into material below. |
| C 36-50" + | Yellowish-red (5YR 5/8) weakly indurated sandstone banded or laminated with shades of red and yellow; slightly acid. |

This moderately deep to deep soil is characterized by moderate to rapid drainage from the surface and moderate drainage internally. Much of this type land was cleared by early settlers for cultivation.

Both soils are low in inherent fertility being very low in phosphorus and nitrogen and low in potassium and calcium. Due to its greater depth and moisture holding capacity the Stephenville soil would be considered a more productive soil than the Darnell.

METHODS AND PROCEDURES

The composition of the overstory vegetation was determined by using the variable radius plot method of Bitterlich (Grosenbaugh, 1952). Thirty random sampling points were used in each of the four study areas. The diameter of each count tree was measured at breast height (DBH) so that number of trees of each diameter class could be calculated on a per acre basis (Afanasiev, 1957). Height of each count tree was also estimated. Plants over two inches DBH were considered trees and those less than two inches were called saplings and seedlings.

Understory vegetation was studied using the meter transect and the square foot methods of analysis. Basal cover at ground level and composition of grasses were determined from 30 randomly located meter transect samples per area. Forb, shrub and oak root sprout numbers were estimated from plant counts in 50 random square foot samples per area.

Annual ring counts were made on one site on the Stephenville soil. Trees which were being sawed down were used for the counts. Diameters of these trees were also recorded.

RESULTS AND DISCUSSION

Species Composition

Overstory Vegetation

There was considerably more post oak than blackjack oak on both soil types (Table 1). However, there was less post oak on the Stephenville soil than on the Darnell. Post oak made up 71.0 percent of the overstory on the Stephenville soil and 85.2 percent on the Darnell. These figures were 27.6 percent and 14.3 percent, respectively, for blackjack oak. This indicates that blackjack oak prefers the deeper more produc-

Table 1. Species composition, total trees per acre, basal area (B.A.), and DBH of trees on two soils.

| SPECIES COMPOSITION TREES* | Soil Type | | | | | |
|-------------------------------|-----------|------|------|--------------|------|------|
| | Darnell | | | Stephenville | | |
| | Site | | Avg. | Site | | Avg. |
| #1 | #2 | #1 | | #2 | | |
| | percent | | | | | |
| <i>Quercus stellata</i> | 79.8 | 90.6 | 85.2 | 73.9 | 68.2 | 71.0 |
| <i>Q. marilandica</i> | 19.2 | 9.4 | 14.3 | 25.5 | 29.4 | 27.6 |
| <i>Celtis occidentalis</i> | 1.1 | --- | 0.5 | 0.5 | --- | --- |
| <i>Quercus shumardii</i> | --- | --- | --- | --- | 1.6 | 0.8 |
| <i>Q. muehlenbergii</i> | --- | --- | --- | --- | 1.0 | 0.5 |
| <i>Morus rubra</i> | --- | --- | --- | --- | T | T |
| <i>Ulmus rubra</i> | --- | --- | --- | --- | T | T |
| TOTAL TREES/ACRE* | 571 | 582 | 576 | 411 | 799 | 605 |
| TOTAL B. A./ACRE (Sq. Ft.) | 45.8 | 60.7 | 53.3 | 68.1 | 78.3 | 73.2 |
| OVERALL AVE. DBH (in.) | | | | | | |
| <i>Quercus stellata</i> | 4.0 | 3.9 | 4.0 | 5.2 | 3.8 | 4.5 |
| <i>Q. marilandica</i> | 4.0 | 5.4 | 4.7 | 5.2 | 4.7 | 5.0 |
| <i>Q. shumardii</i> | --- | --- | --- | --- | 6.1 | 6.1 |

*Over two inches DBH

tive Stephenville soil and post oak is a somewhat better competitor on the shallow, often rocky Darnell soil.

Hackberry (*Celtis occidentalis*) was the only other tree sampled on both soil types. More diversity of tree species was found on the Stephenville than the Darnell soil.

Total number of trees per acre was not greatly different on the two soils (Table 1). The average of two sites for each soil showed 576 trees per acre on the Darnell soil and 605 on the Stephenville. This is considerably higher than the 388 trees and saplings per acre reported by Rice and Penfound (1959) for central Oklahoma. The stands sampled in the present study would probably be representative of some of the more productive cross timbers area of Oklahoma. No doubt this accounts for the divergence shown in trees per acre in the two studies, since the data of Rice and Penfound represent the average of many types of stands sampled throughout central Oklahoma. The total basal area of the overstory was 73.2 square feet per acre on Stephenville and 53.3 on the Darnell soil (Table 1).

Understory Vegetation

Little bluestem (*Andropogon scoparius*) and big bluestem (*A. gerardi*) were the two dominant grass species in the understory vegetation on both soil types (Table 2). The composition of grasses was similar on both soils with a few notable exceptions. There was less *A. scoparius* and more *Panicum scribnerianum* and *Bouteloua curtipendula* on the Stephenville than the Darnell soil.

Most of the grasses occurred in areas where the canopy of the trees allowed some direct light penetration. The forbs and woody plants were distributed throughout, although they were more abundant and vigorous where the overstory was not so dense (Figure 2).

The basal cover of the grasses was 1.7 percent on the Darnell and 0.8 percent on the Stephenville soil (Table II). This is quite low compared with open grassland but is greater than the percent basal cover provided by the trees. The 73.2 square feet basal area per acre on the Stephenville soil is only 0.17 percent basal cover.

Forb and woody understory vegetation was rather sparse with an average of 0.62 plants per square foot on the Darnell and 0.69 on the Stephenville soil (Table III). Poison ivy (*Rhus radicans*) and dogwood (*Cornus drummondii*) were the most abundant broadleaved plants in the understory on the Stephenville soil but did not occur or were rare on



Fig. 2. Understory vegetation was more abundant where the overstory canopy allowed some direct light penetration. This site is on the Stephenville soil.

Table II. Grass composition in post oak-blackjack oak vegetation type on two soils.

| | Soil Type | |
|-------------------------------|-------------|--------------|
| | Darnell | Stephenville |
| Basal Cover | 1.7 | 0.8 |
| SPECIES | | |
| <i>Andropogon scoparius</i> | 53.8 | 43.6 |
| <i>A. gerardi</i> | 28.8 | 26.9 |
| <i>Sorghastrum nutans</i> | 1.9 | --- |
| <i>Panicum scribnerianum</i> | 5.8 | 14.1 |
| <i>Carex spp.</i> | 5.8 | 3.8 |
| <i>Panicum virgatum</i> | 3.8 | 3.8 |
| <i>Muhlenbergia schreberi</i> | --- | 1.3 |
| <i>Bouteloua curtipendula</i> | --- | 6.4 |
| TOTAL | 99.9 | 99.9 |

Table III. Forb and woody plant understory numbers per square feet and per acre on two soils.

| SPECIES | SOIL TYPE | | | |
|------------------------------------|-------------|--------|--------------|--------|
| | Darnell | | Stephenville | |
| | No./sq. ft. | No./A | No./sq. ft. | No./A |
| FORBS | | | | |
| <i>Ambrosia psilostachya</i> | .03 | 1307 | .02 | 871 |
| <i>Acalypha virginica</i> | .02 | 871 | .03 | 871 |
| <i>Vernonia baldwinii</i> | .02 | 871 | .02 | 871 |
| <i>Lespedeza virginica</i> | .01 | 435 | -- | --- |
| WOODY | | | | |
| <i>Symphoricarpos orbiculatus</i> | .23 | 10019 | -- | --- |
| <i>Vitus</i> spp. | .08 | 3485 | .07 | 3049 |
| <i>Quercus stellata</i> * | .07 | 3049 | .05 | 2178 |
| <i>Q. marilandica</i> * | .07 | 3049 | .05 | 2178 |
| <i>Parthenocissus quinquefolia</i> | .02 | 871 | .08 | 3485 |
| <i>Rhus glabra</i> | .02 | 871 | -- | --- |
| <i>R. radicans</i> | --- | ---- | .17 | 7405 |
| <i>Cornus drummondii</i> | --- | ---- | .12 | 5227 |
| <i>Ulmus rubra</i> | .01 | 435 | .02 | 871 |
| Others | .03 | 1307 | .04 | 1742 |
| TOTAL | .62 | 27,005 | .69 | 30,055 |

*Root Sprouts

the Darnell soil; and buskbrush (*Symphoricarpos orbiculatus*), the most abundant on Darnell, rarely occurred on the Stephenville soil. The reason was not apparent.

There was little or no oak reproduction from acorns noted in the study areas. Close examination of the many young oaks less than three feet tall, revealed them to be sprouts from roots of older trees. The number of post oak and blackjack oak root sprouts per acre was the same on both soils, despite the wide difference in numbers of each in the overstory.

Diameter and Height

Most of the trees on both soil types were 3-4 inches DBH (Tables IV and V). The Stephenville soil had fewer trees in the 3-4 inch class and more trees in the 5-6 inch class than the Darnell soil. Approximately 90 percent of the trees on both soils were 6 inches or less DBH. Saplings were quite numerous on both soils. Most of these presumably originated as root sprouts. Trees with diameters exceeding 10 inches were few and widely spaced on both soil types.

Table IV. Number per acre and average heights of post oak and blackjack oak in various diameter classes on STEPHENVILLE soil.*

| Diameter (in. DBH) | Post Oak | | | Blackjack Oak | | | TOTAL | |
|--------------------------------|----------|------|-----------------|---------------|------|-----------------|--------|------|
| | No./A. | Pct. | Avg. Ht. Ft. | No./A. | Pct. | Avg. Ht. Ft. | No./A. | Pct. |
| Saplings: | | | | | | | | |
| 1-2 | 486.1 | --- | 9.9 | 101.6 | --- | 10.7 | 587.7 | --- |
| Trees: | | | | | | | | |
| 3-4 | 279.5 | 65.2 | 18.2 | 91.4 | 55.9 | 16.9 | 370.9 | 62.6 |
| 5-6 | 109.7 | 25.6 | 24.6 | 46.8 | 28.6 | 22.0 | 156.5 | 26.4 |
| 7-8 | 34.0 | 7.9 | 27.7 | 21.7 | 13.3 | 26.2 | 55.7 | 9.4 |
| 9-10 | 5.1 | 1.2 | 29.5 | 2.8 | 1.7 | 27.3 | 7.9 | 1.3 |
| 11-12 | 0.4 | --- | 34.0 | 0.4 | 0.2 | 30.5 | 0.8 | 0.2 |
| 13-14 | --- | --- | --- | 0.2 | 0.1 | 27.0 | 0.2 | 0.1 |
| 15-16 | --- | --- | --- | 0.1 | 0.1 | 28.0 | 0.1 | --- |
| 17-18 | 0.1 | --- | 34.0 | --- | --- | --- | 0.1 | --- |
| TOTAL TREES | 428.8 | | | 163.4 | | | 592.2 | |
| TOTAL TREES and SAPLINGS | 914.9 | | | 265.0 | | | 1180.0 | |

*Average of two sites

Blackjack oak had more large trees on both soils than did post oak. The overall average DBH of post oak and blackjack oak on the Stephenville soil was 4.5 and 5.0 inches, respectively (Table I). For the Darnell soil these diameters were 4.0 inches for post oak and 4.7 inches for blackjack. Shumard's oak (*Quercus shumardii*), which occurred sparingly on the Stephenville soil, averaged 6.1 inches DBH.

Both post oak and blackjack oak were consistently taller at all diameters on the Stephenville than on the Darnell soil (Tables IV and V). Post oak was consistently taller than blackjack oak at all diameters on the same soil. The maximum height attained by post oak was 34 feet on Stephenville and 31 feet on Darnell. For blackjack these figures were 30 and 29 feet respectively.

Post oak and blackjack oak both reached their maximum heights at approximately 12 inches DBH on Stephenville and 16 inches DBH on Darnell. The mature trees flattened out on top.

Annual Ring Counts

Limited annual ring counts indicate it requires around 40 years for post oak or blackjack oak to reach 5 to 6 inches DBH and 22 to 25 feet

Table V. Number per acre and average heights of post oak and blackjack oak in various diameter classes on DARNELL soil.*

| Diameter (in. DBH) | Post Oak | | | Blackjack Oak | | | TOTAL | |
|--------------------------------|----------|------|-----------------|---------------|------|-----------------|--------|------|
| | No./A. | Pct. | Avg. Ht. Ft. | No./A. | Pct. | Avg. Ht. Ft. | No./A. | Pct. |
| Saplings: | | | | | | | | |
| 1-2 | 593.5 | --- | 10.3 | 68.2 | --- | 12.3 | 661.7 | --- |
| Trees: | | | | | | | | |
| 3-4 | 362.7 | 73.8 | 15.9 | 61.6 | 71.8 | 13.3 | 424.3 | 73.5 |
| 5-6 | 100.5 | 20.4 | 22.7 | 10.8 | 12.6 | 19.6 | 111.3 | 19.3 |
| 7-8 | 18.7 | 3.8 | 24.1 | 7.0 | 8.2 | 21.1 | 25.7 | 4.4 |
| 9-10 | 3.6 | 0.7 | 24.5 | 4.1 | 4.8 | 23.9 | 7.7 | 1.3 |
| 11-12 | 4.3 | 0.9 | 29.1 | 1.0 | 1.2 | 27.3 | 5.3 | 0.9 |
| 13-14 | 1.6 | 0.3 | 30.5 | 1.1 | 1.3 | 27.5 | 2.7 | 0.5 |
| 15-16 | 0.1 | --- | 31.5 | 0.2 | 0.2 | 29.0 | 0.3 | 0.1 |
| 17-18 | 0.2 | --- | 31.0 | --- | --- | --- | 0.2 | 0.1 |
| TOTAL TREES | 491.6 | | | 85.8 | | | 577.4 | |
| TOTAL TREES and SAPLINGS | 1085.1 | | | 154.0 | | | 1239.1 | |

*Average of two sites

on height on the Stephenville soil (Table VI). Comparable counts were not obtained for the Darnell soil. Based on the number of trees in the 3-6 inch diameter class shown in Table IV and the age of trees of these diameters, the majority of the trees are less than 20 years old on the Stephenville soil. This would probably be similar for the Darnell soil. The largest tree on which annual rings were counted was a post oak nine inches DBH with 58 rings (Table IV).

SUMMARY

The main objective of the study was to determine what influence soil type has on the vegetative cover in post oak-blackjack oak communities in central Oklahoma. Two sites each were selected for study on the Darnell and Stephenville soil types near Stillwater, Oklahoma.

Post oak was dominant on all sites but was less abundant on the Stephenville than on the Darnell soil type. Blackjack oak appeared to prefer the deeper, more productive Stephenville soil. There was greater diversity of species on the Stephenville soil.

Table VI. Annual ring counts of post oak and blackjack oak on Stephenville soil.

| DBH (in.) | Post Oak | | Blackjack Oak | |
|--------------|------------------------|------------------------|------------------------|------------------------|
| | Avg. No. Ann. Rings | No. Trees per Count | Avg. No. Ann. Rings | No. Trees per Count |
| 1 | 12.4 | 5 | 10 | 2 |
| 2 | 14.1 | 12 | 16.7 | 9 |
| 3 | 20.9 | 13 | 19.1 | 7 |
| 4 | 22.2 | 12 | 33.8 | 6 |
| 5 | 38.3 | 7 | 40.0 | 4 |
| 6 | 33.0 | 1 | 39.0 | 1 |
| 7 | 49.5 | 4 | --- | --- |
| 8 | --- | --- | --- | --- |
| 9 | 58.0 | 1 | --- | --- |

The basal area of the overstory was 53.3 square feet per acre on the Darnell and 73.2 square feet on the Stephenville soil. There were slightly more trees and saplings per acre on the Darnell soil.

Andropogon scoparius and *A. gerardi* were the two dominant grass species on both soil types. *Rhus radicans* and *Cornus drummondii* were the most abundant broadleaved understory plants on the Stephenville soil but did not occur or were rare on the Darnell; and *Symphoricarpos orbiculatus*, the most abundant on the Darnell rarely occurred on the Stephenville soil. Forbs were relatively unimportant on both soil types.

Approximately 90 percent of the trees on both soils were in the 3-6 inch diameter class. The overall average DBH of blackjack was greater than post oak in both soil types.

Both post oak and blackjack oak were consistently taller at all diameters on the Stephenville than the Darnell soil.

Limited annual ring counts indicate it requires around 40 years for post oak or blackjack to reach 5 to 6 inches DBH and 22 to 25 feet in height on the Stephenville soil.

LITERATURE CITED

- Afanasiev, Michael. 1957. The Bitterlich method of cruising—why does it work? Jour. Forestry 55:216-217.
- Bruner, W. E. 1931. Vegetation of Oklahoma. Ecol. Mono. 1:99-188.

- Dyksterhuis, E. J. 1948. The vegetation of the western cross timbers. Ecol. Mono. 18:325-376.
- Gray, Fenton and H. M. Galloway. 1959. Soils of Oklahoma. Misc. Publ. MP-56.
- Grosenbaugh, L. R. 1952. Plotless timber estimates-new, fast, easy. Jour. Forestry 50:32-37.
- Rice, E. L. and W. T. Penfound. 1959. The upland forests of Oklahoma. Ecol. 40:593-608.
- Soil Conservation Service Mimeo. 1961. Description of soil series profiles.