EDAPHIC AND TOPOGRAPHIC EFFECTS
ON FOREST COMMUNITIES IN
PAYNE COUNTY, OKLAHOMA

By

GEORGE RALPH PARKER

Bachelor of Science

Oklahoma State University

1964

Submitted to the faculty of the Graduate College of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
MASTER OF SCIENCE
July, 1967

EDAPHIC AND TOPOGRAPHIC EFFECTS

ON FOREST COMMUNITIES IN

PAYNE COUNTY, OKLAHOMA

Thesis Approved:

Thesis Adviser

Dean of the Graduate College

ACKNOWLEDGEMENTS

The writer would like to express his appreciation to Dr. Jerry J. Crockett under whose guidance and encouragement this work was carried out, and the other committee members, Dr. John E. Thomas and Mr. Nat Walker. Appreciation also goes to Mr. James R. Culver, U. S. Department of Agriculture Soils Scientist, for his valuable help in field identification of the soil series sampled.

Appreciation is also extended to all others not specifically mentioned who aided in this study.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF APPENDICES

CHAPTER I.

INTRODUCTION

Many studies concerning vegetation and soil characteristics are reported in the literature (Bruner, 1931; Diebold, 1935; Dyksterhuis, 1948; Rice and Penfound, 1959; Whittaker, 1960; and Rice, 1965). Few studies correlating forested communities with definite soil series are available (Buck, 1964).

This study was done to determine whether forested communities are significantly different on five different soil series in the area of Payne County, Oklahoma. The topography of one soil series was quite varied; therefore, slope exposure in this case was also considered. Rice and Penfound (1959) reported on the upland forests of north central Oklahoma, and Rice (1965) reported on the bottomland forests of this area, but no distinction was made as to soil series or topography.

CHAPTER II.

DESCRIPTION OF STUDY AREA

Payne County is located in the north central part of Oklahoma, approximately 120 miles from the Arkansas line on the east, 50 miles from the Kansas line on the north, and 150 miles from the Texas line on the west. It is approximately 42 miles wide between the east-west borders and approximately 21 miles wide between the north-south borders. In total land area it covers 444,800 acres.

The county is believed to be in the transition area between the plains of the west and the prairies of the east (Cobb, 1918). Most of the county is characteristic of the tall grass prairie.

Forest communities constitute a small part of the total land area in the county. The upland forests are limited to broken areas of sandy soil scattered throughout the county. These areas are usually level along the flood plain of the Cimarron River but become rolling to undulating in other parts.

The bottomland forest communities are limited to narrow bands along the streams of the county. The soils are generally heavier and more mesic. These areas are usually level; consequently, many forest communities are being cleared for agricultural purposes.

The highest point, 1,150 feet above sea level, occurs 4 miles west of Yale; and the lowest, 800 feet above sea level, occurs along the Cimarron River between Cushing and Yale. The central part averages between 900 and 1,000 feet above sea level.

Most of the county is drained by the Cimarron River and its tributaries. Stillwater Creek extends from the northwest to the south central part of the county, Salt Creek is the major drainage of the northeast, and Euchee Creek drains the southeast. The northern part of the county is drained by Long Branch Creek which empties into Black Bear Creek and finally into the Arkansas River.

Payne County is characterized by hot summers and variable winters. Mean temperature for the ten-year period 1951 to 1960 averaged 61 degrees Fahrenheit. Summer temperature may frequently exceed 100 degrees Fahrenheit accompanied by hot winds. Winter temperatures have been recorded from -18 degrees Fahrenheit to 90 degrees Fahrenheit.

The last killing frost of the spring usually occurs in April, and the first killing frost of the fall is generally in October. Mean number of frost-free days at Stillwater from 1951 to 1960 was 211 (Climatography of the United States, 1962).

Mean precipitation varied from 32.18 inches at Stillwater to 33.45 inches at Cushing for the same period. Most of the precipitation occurs from June to October with occasional light snows occurring during the winter months. Precipitation is frequently poorly distributed with long, dry periods.

The upland soils of Payne County are derived from the rocks of the Permian and the Pennsylvanian periods of the Palezoic Era. Sandstones and shales of the Permian Red Beds gave rise to most western soils; and sandstones, shales, and limestones of the Pennsylvanian period gave rise to most eastern soils. These soils have, over time, developed definite characteristics due to topography, climate, and vegetation, and have been classified into series (Cobb, 1918).

Rice and Penfound (1959) found post oak (Quercus stellata)[1] and blackjack oak (Quercus marilandica) to be major dominants on the sandy upland soils of Payne County. Weaver and Clements (1938) believe these oaks constitute a post climax condition under the existing prairie climate. Dyksterhuis (1948) believes the present oak forests to be a disclimax due to overgrazing and the lack of fire.

Bruner (1931) found a sharp transition between the silt loam soils of the grasslands and sandy soils of the upland forests in the eastern part of the county. These sandy soils vary from a few inches to several feet in depth and are very coarse in texture. Because of this, much water percolates down and drains away through the crevices in the underlying sandstone. Blackjack oak occupies the more xeric sites, while post oak dominates more mesic sites of these sandy soils.

The bottomland soils are dominated by American elm (Ulmus americana) with hackberry (Celtis spp.) being of secondary importance (Rice, 1965). Data from this study listed American elm as dominant on all five stands sampled while hackberry was a minor dominant on only one. Chemical analysis of these soils were made, but no distinction was made between soil series.

At least ten different soil series occur under forest communities within Payne County (Extension Service Map, 1963). Several of these are not extensive and are interspersed so that sampling is difficult. Five of the most distinguishable are briefly described (Soil Survey, U. S. Department of Agriculture).

---

[1]Botanical nomenclature will follow that of Waterfall, 1966.

Stephenville Series

The Stephenville soil series occurs on undulating to gently rolling upland with gradients of 2 to 10 per cent. The A horizon is usually a fine sandy loam, varying in color from very pale brown to grayish brown and ranging in depth from 5 to 15 inches. The B horizon is characterized by a sandy clay loam, 15 to 36 inches in depth, and is yellowish red in color. This is underlain by friable sandy loam or soft sandstone occurring from 30 to 50 inches in depth. Drainage is moderate to rapid from the surface and moderate internally.

Darnell Series

The Darnell soil series occurs on slopes and narrow ridge tops with gradients up to 15 per cent. It occurs in close association with the Stephenville series, so both were sampled as one complex. The A horizon is a grayish-brown to brown fine sandy loam 5 to 12 inches in depth. The B horizon, 2 to 5 inches thick, is a reddish-brown light loam. Sandstone outcrops are common, with sandstone bedrock ranging from 6 to 20 inches in depth within a radius of a few feet. Drainage is rapid from both the surface and internally.

Konawa Series

The Konawa series occurs on nearly level to sloping uplands between 1 and 8 per cent. The A horizon varies from 7 to 20 inches in thickness and is a grayish to pale brown loamy fine sand. The B horizon is a very hard, yellowish-red sandy clay loam, varying from 44 to 56 inches in thickness. The C horizon ranges from a yellowish-red loamy fine sand to light sandy clay loam. This soil is well drained with moderate permeability.

Port Series

The Port soil series occurs along the flood plains of streams with entrenched channels. A brown silty clay loam, 14 to 30 inches in depth, characterizes the A horizon. Horizons B and C range in color from reddish-brown to yellowish-brown and in texture from clay loams to silty clay. Since this is an alluvial soil, dark horizons of buried soils at depths of 3 to 5 feet below the surface are not uncommon. Drainage is slow from the surface and moderate internally.

Alluvial Complex

These immature soils are found along the minor streams of the area. They were located mainly due to location and are a mixture of several minor soil types. In most cases there are no definite soil horizons. Drainage varies with texture and per cent of slope. The Oklahoma Soil Conservation Service recognizes this complex as "prairie drainageways."

Yahola Series

The Yahola series is found on nearly level flood plains. They form in slightly altered, moderately coarse-textured stream alluvium and may be subject to frequent flooding. The A horizon varies from a reddish-brown fine sandy loam to loam and is 4 to 20 inches in depth. The B horizon is absent. Loam to loamy very fine sand characterize the C horizon. Stratification of coarser or finer soil material typically occurs within the 10- to 40-inch range of this series. The

C horizon is usually structureless. This series is well drained with slow runoff and moderately rapid permeability.

CHAPTER III.

METHODS AND PROCEDURES

Five representative soil series were selected on the basis of their distribution over the county and the extent of forest communities on each. Since sampling was to be done from the western edge to the eastern edge of the county, each soil series selected was distributed accordingly. Many forest communities have been cleared for agricultural purposes, limiting the number of possible sample sites. Also, minor soil series are limited in their extent in any one area of the county; thus, many of the areas were considered too small for proper sampling.

Aerial mosaics and a U. S. Department of Agriculture Soil Survey Map of Payne County were used to tentatively locate study areas. Field inspection was then made to locate the least disturbed area and the soil series to be sampled. All areas had some disturbance. Only areas exceeding three acres were sampled.

Soil series were identified in the field by visual and textural qualities only. Although soil samples were taken, they were not chemically tested since each soil series served only as the control on which to study variation of the existing forest community.

A total of 33 areas were sampled representing all five soil series. Since the Stephenville series and the Darnell series are in such close association, they were sampled as one complex. Topography of this complex was rolling to undulating; therefore, five eastern, five western, and four level areas were sampled and compared separately. This is the only complex in which topography was used as a variable. All five study areas of the Konawa series are located east-west across the county on the upper flood plain of the Cimarron River. Five study areas were sampled on the Port series. Three of these are on Stillwater Creek. The last two are located on Long Branch and Euchee Creeks. Only four study areas were sampled on the Yahola series. These are all located adjacent to the Cimarron River, east-west across the county. The five study areas of the Alluvial complex are scattered over the county along different minor drainages.

Basal area, frequency, and density of forest species were sampled using the variable plot and arms length rectangle methods as reported by Rice and Penfound (1955). Basal area was estimated on 40 points in each stand using a relaskop.[2] Two stands were sampled with less than 40 points because of their small size. Frequency and density were estimated by 40 arms length rectangles of 0.01 acre each. Stems of 3.0 inches or more in diameter at breast height were considered to be trees; those less than 3.0 inches but greater than 1.0 inch were considered saplings. Seedlings (less than 1.0 inch d.b.h.) were not sampled.

Basal area in square feet per acre, number of trees per acre, and frequency were computed for each species. Means were taken for the sum of each species on each soil series or complex. Number of saplings

---

[2]An instrument which will function as a rangefinder, dendrometer, clinometer, and angle gauge with slope correction. Developed by Dr. W. Bitterlich of Austria.

per acre and frequency were computed for saplings in the same manner.

Relative basal area, relative density, and relative frequency were computed and summed for the importance value of each tree species (Curtis and McIntosh, 1951). A species with an importance value of 75 or greater is considered dominant (Rice, 1965).

Mean importance values for major species of each soil series or complex were computed. A Student's "t" test was then used to test for significant differences of mean values (Steel and Torrie, 1960). Standard errors were also computed.

CHAPTER IV.

RESULTS AND DISCUSSION

A total of 33 tree species were recorded on the 33 study areas sampled. Based on their mean importance value per soil series, 8 of the most important species were selected and statistically tested. Post oak was the most important species on all upland soil series sampled being dominant on all areas. Blackjack oak was dominant on 10 of the 19 areas sampled on the upland soil series and was second in importance. Of the bottomland soil series sampled, American elm was dominant on 9 areas, and hackberry was dominant on 7 of the 14 sample areas. Bur oak (*Quercus macrocarpa*), black walnut (*Juglans nigra*), eastern cottonwood (*Populus deltoides*), and ash (*Fraxinus* spp.) were of secondary importance on these sites (Table I).[3]

Stephenville-Darnell Soil Complex (Eastern Slope)

Of the eleven species found on the eastern slope of the Stephenville-Darnell soil complex, post oak was dominant on all five areas sampled with a mean importance value (i.v.) of 190.5 (Table II), a mean density of 216.6 (Table III) trees per acre, a mean frequency of 62.8 per cent (Table IV), and a mean basal area of 43.7 square feet

---

[3]Each soil series will be abbreviated as follows in all table headings: Stephenville-Darnell, eastern slope, S-D(E); western slope, S-D(W); level exposure, S-D(L); Konawa, K; Port, P; Alluvial, A; and Yahola, Y.

per acre (Table V). Of secondary importance is blackjack oak, being dominant on three of the five areas with a mean i.v. of 92.2, 84.5 trees per acre, 37.9 per cent frequency, and 19.6 square feet per acre. All other species were of rare occurrence with a mean i.v. below 10. Mean basal area and mean density for all species of this slope exposure were 65 square feet per acre and 315.2 trees per acre respectively.

TABLE I.

NUMBER OF STANDS ON WHICH SPECIES WAS DOMINANT PER SOIL SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y	Total No. of Stands
	(E)	(L)	(W)					
Ulmus americana					2	4	3	9
Celtis spp.					5	1	1	7
Carya illinoensis							1	1
Fraxinus spp.						1		1
Quercus macrocarpa						1		1
Quercus stellata	5	4	5	5				19
Quercus marilandica	3	2	2	3				10

TABLE II.

MEAN IMPORTANCE VALUE FOR EACH SPECIES SAMPLED

PER SOIL SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y
	(E)	(L)	(W)				
Acer Negundo	-	-	-	-	11.2	4.2	4.6
Acer saccharinum	-	-	-	-	0.2	-	-
Bumelia lanuginosa	3.6	8.6	2.0	0.2	6.2	6.6	4.2
Carya aquatica	-	-	-	-	1.2	-	-
Carya cordiformis	-	3.1	9.3	18.4	0.9	1.3	-
Carya illinoensis	-	-	-	-	7.1	0.3	20.2
Carya ovalis	-	-	-	-	-	-	0.4
Carya tomentosa	-	-	-	-	1.8	-	0.4
Celtis spp.	5.2	0.3	1.0	2.3	97.8	45.2	38.6
Cercis canadensis	0.1	-	-	1.8	1.6	5.8	13.0
Diospyros virginiana	-	-	-	-	-	5.1	1.5
Fraxinus spp.	-	-	0.1	-	16.9	45.6	3.6
Gleditsia triacanthos	2.1	-	-	-	1.0	1.9	7.2
Gymnocladus dioica	-	-	-	-	3.5	3.9	6.1
Juglans nigra	-	-	-	-	22.9	5.6	17.2
Juniperus virginiana	0.9	0.3	1.0	4.4	-	7.7	20.1
Maclura pomifera	-	-	-	-	1.0	-	-
Morus alba	-	-	-	-	3.8	-	-
Morus rubra	1.8	1.2	0.2	4.9	9.6	10.9	2.6
Platanus occidentalis	-	-	-	-	2.9	-	1.0
Populus deltoides	-	-	-	-	4.2	1.1	22.5
Prunus spp.	0.8	0.1	0.7	0.7	-	1.1	0.1
Quercus macrocarpa	-	-	-	-	23.2	27.8	8.8
Quercus marilandica	92.2	75.0	51.7	92.8	-	2.4	-
Quercus Muehlenbergii	1.7	0.5	1.9	3.5	0.2	7.7	10.2
Quercus Shumardii	-	-	2.7	-	5.9	-	4.2
Quercus stellata	190.5	210.0	228.9	167.2	-	9.3	0.5
Quercus velutina	-	-	-	3.1	-	-	-
Sapindus Drummondii	-	-	-	-	4.3	9.6	17.0
Salix nigra	-	-	-	-	-	0.2	5.4
Ulmus americana	1.0	0.3	0.6	0.3	70.9	85.6	84.6
Ulmus rubra	-	-	-	0.5	3.1	10.1	6.0
TOTAL	299.8	299.7	300.1	300.1	300.3	299.0	299.8

TABLE III.

MEAN DENSITY IN TREES PER ACRE FOR EACH SPECIES

SAMPLED PER SOIL SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y
	(E)	(L)	(W)				
Acer Negundo	-	-	-	-	5.5	2.0	1.3
Acer saccharinum	-	-	-	-	-	-	-
Bumelia lanuginosa	4.5	8.1	1.0	-	5.0	2.5	1.2
Carya aquatica	-	-	-	-	1.0	-	-
Carya cordiformis	-	3.8	5.0	16.0	0.5	0.5	-
Carya illinoensis	-	-	-	-	0.5	-	7.5
Carya ovalis	-	-	-	-	-	-	-
Carya tomentosa	-	-	-	-	1.0	-	-
Celtis spp.	4.0	-	0.5	1.5	61.5	32.9	13.9
Cercis canadensis	-	-	-	1.5	1.0	4.2	4.9
Diospyros virginiana	-	-	-	-	-	3.0	0.6
Fraxinus spp.	-	-	-	-	8.5	62.8	1.9
Gleditsia triacanthos	1.1	-	-	-	0.5	0.8	2.5
Gymnocladus dioica	-	-	-	-	2.0	2.0	2.0
Juglans nigra	-	-	-	-	9.0	2.5	5.8
Juniperus virginiana	0.5	-	0.5	3.5	-	3.0	7.5
Maclura pomifera	-	-	-	-	0.5	-	-
Morus alba	-	-	-	-	2.0	-	-
Morus rubra	1.5	0.6	-	3.5	7.0	8.4	0.6
Platanus occidentalis	-	-	-	-	0.5	-	-
Populus deltoides	-	-	-	-	0.5	-	3.8
Prunus spp.	0.5	1.0	0.5	-	-	0.5	-
Quercus macrocarpa	-	-	-	-	7.5	7.0	3.1
Quercus marilandica	84.5	65.1	42.5	80.5	-	1.0	-
Quercus Muehlenbergii	1.5	-	1.0	-	-	3.5	2.0
Quercus Shumardii	-	-	-	-	3.0	-	0.6
Quercus stellata	216.6	235.6	221.5	163.2	-	3.5	-
Quercus velutina	-	-	-	2.0	-	-	-
Sapindus Drummondii	-	-	-	-	4.0	8.0	8.0
Salix nigra	-	-	-	-	-	-	2.0
Ulmus americana	0.5	-	0.5	-	34.5	52.6	23.4
Ulmus rubra	-	-	-	0.5	1.5	6.5	2.0
TOTAL	315.2	314.2	273.0	272.2	157.0	207.2	94.6

TABLE IV.

MEAN FREQUENCY IN PER CENT OF EACH SPECIES SAMPLED

PER SOIL SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y
	(E)	(L)	(W)				
Acer Negundo	-	-	-	-	4.0	2.0	1.3
Acer saccharinum	-	-	-	-	-	-	-
Bumelia lanuginosa	2.2	5.6	1.0	-	4.0	2.5	1.2
Carya aquatica	-	-	-	-	0.5	-	-
Carya cordiformis	-	3.1	4.0	10.0	0.5	0.5	-
Carya illinoensis	-	-	-	-	0.5	-	6.2
Carya ovalis	-	-	-	-	-	-	-
Carya tomentosa	-	-	-	-	1.0	-	-
Celtis spp.	3.0	-	0.5	1.5	39.0	21.8	12.6
Cercis canadensis	-	-	-	1.0	1.0	3.4	3.5
Diospyros virginiana	-	-	-	-	-	1.5	0.6
Fraxinus spp.	-	-	-	-	6.0	19.8	0.6
Gleditsia triacanthos	1.1	-	-	-	0.5	0.8	1.9
Gymnocladus dioica	-	-	-	-	1.5	2.0	2.0
Juglans nigra	-	-	-	-	7.0	2.5	3.9
Juniperus virginiana	0.5	-	0.5	3.0	-	2.4	4.4
Maclura pomifera	-	-	-	-	0.5	-	-
Morus alba	-	-	-	-	1.5	-	-
Morus rubra	1.0	0.6	-	3.5	4.5	4.5	0.6
Platanus occidentalis	-	-	-	-	0.5	-	-
Populus deltoides	-	-	-	-	0.5	-	2.6
Prunus spp.	0.5	0.5	0.5	-	-	0.5	-
Quercus macrocarpa	-	-	-	-	7.5	5.5	1.9
Quercus marilandica	37.9	36.2	25.5	43.0	-	1.0	-
Quercus Muehlenbergii	1.5	-	1.0	-	-	2.0	2.0
Quercus Shumardii	-	-	-	-	2.0	-	0.6
Quercus stellata	62.8	70.3	73.7	70.0	-	2.0	-
Quercus velutina	-	-	-	2.0	-	-	-
Sapindus Drummondii	-	-	-	-	3.0	4.0	3.3
Salix nigra	-	-	-	-	-	-	1.9
Ulmus americana	0.5	-	0.5	-	23.5	28.6	15.2
Ulmus rubra	-	-	-	0.5	1.5	5.0	1.3

TABLE V.

MEAN BASAL AREA IN SQUARE FEET PER ACRE FOR EACH SPECIES

SAMPLED PER SOIL SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y
	(E)	(L)	(W)				
Acer Negundo	-	-	-	-	2.6	1.2	0.4
Acer saccharinum	-	-	-	-	0.2	-	-
Bumelia lanuginosa	0.2	0.3	0.4	0.2	0.8	0.8	0.6
Carya aquatica	-	-	-	-	0.2	-	-
Carya cordiformis	-	0.2	2.0	4.2	0.2	0.2	-
Carya illinoensis	-	-	-	-	4.8	0.2	3.1
Carya ovalis	-	-	-	-	-	-	0.2
Carya tomentosa	-	-	-	-	0.3	-	0.2
Celtis spp.	0.8	0.3	0.2	0.4	19.4	12.8	3.9
Cercis canadensis	0.1	-	-	0.3	0.6	0.6	0.8
Diospyros virginiana	-	-	-	-	-	0.2	0.2
Fraxinus spp.	-	-	0.1	-	4.8	15.7	0.6
Gleditsia triacanthos	0.2	-	-	-	0.2	0.5	0.8
Gymnocladus dioica	-	-	-	-	1.2	0.7	0.5
Juglans nigra	-	-	-	-	8.6	1.5	3.0
Juniperus virginiana	0.2	0.2	0.1	0.6	-	1.2	1.4
Maclura pomifera	-	-	-	-	-	-	-
Morus alba	-	-	-	-	0.4	-	-
Morus rubra	0.2	0.2	0.1	0.8	1.2	2.0	0.6
Platanus occidentalis	-	-	-	-	1.8	-	0.7
Populus deltoides	-	-	-	-	2.6	0.7	8.4
Prunus spp.	-	0.1	-	0.1	-	0.1	0.1
Quercus macrocarpa	-	-	-	-	10.4	10.5	1.9
Quercus marilandica	19.6	14.9	7.9	24.4	-	0.2	-
Quercus Muehlenbergii	-	0.4	0.4	0.1	0.2	1.9	2.9
Quercus Shumardii	-	-	0.2	-	1.2	-	1.6
Quercus stellata	43.7	40.6	45.0	43.0	-	2.9	0.2
Quercus velutina	-	-	-	0.4	-	-	-
Sapindus Drummondii	-	-	-	-	0.2	1.8	1.4
Salix nigra	-	-	-	-	-	0.2	-
Ulmus americana	-	0.2	0.1	0.2	21.5	25.3	22.6
Ulmus rubra	-	-	-	-	1.0	0.8	0.9
TOTAL	65.0	57.4	56.5	74.7	84.4	82.0	57.0

In density of saplings, post oak had 207.5 saplings per acre while blackjack oak had a density of 83.9 saplings per acre (Table VI). The frequency of saplings was 47.4 per cent for post oak and 27.2 per cent for blackjack oak (Table VII). This would indicate a uniform distribution of these two species with time since the mean values for saplings closely correlates with the mean values of the trees. There was a slight increase in mean values of saplings for post oak with a corresponding decrease for those of blackjack oak, but this was not large enough to be significant.

This slope exposure was not significantly different from other upland soil series and slope exposures based on mean importance values of post oak and blackjack oak at the 1 or 5 per cent levels. The mean importance value for post oak is lower on this slope exposure than for either the level upland or western slope, but is slightly higher than that on the Konawa soil series. The mean i.v. of blackjack oak on this slope exposure is greater than on the level or western slope and nearly equals the value for the Konawa soil series.

The Stephenville-Darnell soil complex (eastern slope) can be distinguished from the bottomland soil series at the 1 per cent level of significance based on mean importance values of post oak and blackjack oak. Post oak had mean importance values of 9.3 on the Alluvial soil complex, 0.5 on the Yahola soil series, and was absent from the Port soil series. Blackjack oak is absent from the Port and Yahola soil series but had a mean importance value of 2.4 on the Alluvial soil complex.

TABLE VI.

MEAN DENSITY OF SAPLINGS PER SOIL

SERIES AND SLOPE EXPOSURE

	S-D			K	P	A	Y
	(E)	(L)	(W)				
Acer Negundo	-	-	-	-	10.5	0.5	9.7
Acer saccharinum	-	-	-	-	-	-	-
Bumelia lanuginosa	8.1	2.5	4.5	3.0	4.0	-	1.2
Carya aquatica	-	-	-	-	-	-	-
Carya cordiformis	-	8.1	27.0	11.5	0.5	-	-
Carya illinoensis	-	-	-	-	4.5	-	3.1
Carya ovalis	-	-	-	-	-	-	-
Carya tomentosa	-	-	-	-	2.0	-	2.1
Celtis spp.	6.6	4.4	2.0	-	72.0	16.8	13.5
Cercis canadensis	1.0	-	0.5	1.5	6.5	12.9	10.4
Diospyros virginiana	-	-	-	-	-	-	-
Fraxinus spp.	-	-	-	-	2.5	12.0	0.6
Gleditsia triacanthos	0.6	-	-	-	-	0.5	1.9
Gymnocladus dioica	-	-	-	-	-	15.0	3.5
Juglans nigra	-	-	-	-	1.5	0.8	2.5
Juniperus virginiana	2.0	0.6	5.0	5.5	-	8.5	7.5
Maclura pomifera	-	-	-	-	-	-	-
Morus alba	-	-	-	-	8.0	-	-
Morus rubra	2.1	-	1.0	3.0	5.5	5.5	4.5
Platanus occidentalis	-	-	-	-	-	-	0.6
Populus deltoides	-	-	-	-	-	-	1.2
Prunus spp.	0.5	0.6	-	-	-	1.0	-
Quercus macrocarpa	-	-	-	-	-	-	1.2
Quercus marilandica	83.9	42.5	33.5	39.1	-	-	-
Quercus Muehlenbergii	0.5	8.8	-	5.5	0.5	1.5	0.7
Quercus Shumardii	-	-	1.0	-	-	-	0.6
Quercus stellata	207.5	203.1	165.0	172.6	-	-	-
Quercus velutina	-	-	-	0.5	-	-	-
Sapindus Drummondii	0.5	-	-	-	11.0	10.5	20.6
Salix nigra	-	-	-	-	-	-	2.5
Ulmus alata	-	-	0.5	-	-	-	-
Ulmus americana	1.1	0.6	0.5	-	11.5	45.9	6.3
Ulmus rubra	-	-	-	-	12.0	-	3.3

TABLE VII.

MEAN FREQUENCY OF SAPLINGS PER

SOIL SERIES AND SLOPE EXPOSURE

	S-D (E)	S-D (L)	S-D (W)	K	P	A	Y
Acer Negundo	-	-	-	-	6.0	0.5	4.8
Acer saccharinum	-	-	-	-	-	-	-
Bumelia lanuginosa	4.1	1.9	3.8	3.0	3.0	-	1.2
Carya aquatica	-	-	-	-	-	-	-
Carya cordiformis	-	7.5	13.0	9.1	0.5	-	-
Carya illinoensis	-	-	-	-	1.5	-	2.5
Carya ovalis	-	-	-	-	-	-	-
Carya tomentosa	-	-	-	-	1.0	-	2.1
Celtis spp.	5.6	3.7	2.0	2.5	38.0	8.4	8.4
Cercis canadensis	0.5	-	0.5	1.0	3.5	5.7	4.8
Diospyros virginiana	-	-	-	-	-	-	-
Fraxinus spp.	-	-	-	-	2.0	8.5	0.6
Gleditsia triacanthos	0.6	-	-	-	-	0.5	0.6
Gymnocladus dioica	-	-	-	-	-	2.5	0.7
Juglans nigra	-	-	-	-	1.0	0.8	1.9
Juniperus virginiana	2.0	0.6	4.0	5.0	-	7.5	6.2
Maclura pomifera	-	-	-	-	-	-	-
Morus alba	-	-	-	-	4.0	-	-
Morus rubra	1.1	-	1.0	3.0	5.0	5.0	3.3
Platanus occidentalis	-	-	-	-	-	-	0.6
Populus deltoides	-	-	-	-	-	-	1.2
Prunus spp.	0.5	0.6	-	-	-	1.0	-
Quercus macrocarpa	-	-	-	-	-	-	1.2
Quercus marilandica	27.2	18.8	17.5	17.5	-	-	-
Quercus Muehlenbergii	0.5	1.9	-	3.5	0.5	0.5	0.7
Quercus Shumardii	-	-	1.0	-	-	-	0.6
Quercus stellata	47.4	66.9	60.5	59.5	-	-	-
Quercus velutina	-	-	-	0.5	-	-	-
Sapindus Drummondii	0.5	-	-	-	2.5	5.0	9.5
Salix nigra	-	-	-	-	-	-	0.6
Ulmus alata	-	-	0.5	-	-	-	-
Ulmus americana	1.1	0.6	-	-	9.0	15.6	15.3
Ulmus rubra	-	-	-	-	6.0	-	2.0

Stephenville-Darnell Soil Complex (Level Exposure)

Ten species were found on the level areas of the Stephenville-Darnell soil complex. Due to the undulating topography, only four sites were sampled as level in this soil complex. Post oak was dominant on all four areas, and blackjack oak was dominant on only two. Mean values for post oak were importance value of 210.0, basal area of 40.6 square feet per acre, density of 235.6 trees per acre, and frequency of 70.3 per cent. Blackjack oak had mean values of 75.0, 14.9 square feet per acre, 65.1 trees per acre, and 36.2 per cent respectively. All other species are rare in occurrence. Bitternut hickory (Carya cordiformis) was present on one site but was not found on the eastern exposure. Mean basal area and mean density for all species of this slope exposure were 57.4 square feet per acre and 314.2 trees per acre respectively.

Mean density of saplings was 203.1 per acre for post oak and 42.5 per acre for blackjack oak. This is only a minor decrease for post oak, but represents nearly a 50 per cent decrease for blackjack oak when compared to the eastern slope. This decrease is probably due to greater drainage from the higher level sites.

Mean frequency of saplings for post oak was 66.9 per cent, which is a 19.5 per cent increase over the eastern slope. This indicates a greater dispersal of post oak saplings over the sites. Blackjack oak decreased in mean frequency to 18.8 per cent, which is proportional to the decrease in mean density.

Based on mean importance values of post oak and blackjack oak, the level sites cannot be differentiated from other upland sites at the 5 per cent or 1 per cent levels of significance (Tables VIII and

IX). Post oak increased in mean importance value compared to eastern slopes of the soil series and to the Konawa soil series. There was a corresponding decrease in mean importance value of blackjack oak.

TABLE VIII.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF QUERCUS STELLATA

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	190.5 ± 28.5						
S-D(L)	4	210.3 ± 18.7						
S-D(W)	5	228.8 ± 10.8						
K	5	167.2 ± 27.1						
P	5	0.0 ± 0.0	**	**	**	**		
A	5	9.3 ± 6.7	**	**	**	**		
Y	4	0.4 ± 0.3	**	**	**	**		

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

Based on mean importance values of post oak and blackjack oak, this slope exposure was found to be significantly different at the 1 per cent level from all bottomland soil series.

Stephenville-Darnell Soil Complex (Western Slope)

Twelve species were sampled on the western slope of the Stephenville-Darnell soil complex. Post oak was dominant on all five areas sampled. Blackjack oak was dominant on two of the five areas. Mean values of post oak were i.v. of 228.9, basal area of 45.0 square feet per acre, density of 221.5 trees per acre, and frequency of 73.7 per cent. Blackjack oak decreased in importance from the eastern and level exposures with mean values of 51.7, 7.9 square feet per acre, 42.5 trees per acre, and 25.5 per cent. Bitternut hickory occurred on three of the five sites with a mean importance value of 9.3. Mean basal area and mean density for all species of this slope exposure were 56.5 square feet per acre and 273.0 trees per acre respectively.

TABLE IX.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF *QUERCUS MARILANDICA*

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	92.2 ± 27.6						
S-D(L)	4	75.0 ± 20.0						
S-D(W)	5	51.7 ± 15.0						
K	5	92.8 ± 25.0						
P	5	0.0 ± 0.0	**	**	*	**		
A	5	2.4 ± 1.5	**	**	**	**		
Y	4	0.0 ± 0.0	**	**	**	**		

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

This slope exposure cannot be distinguished from other upland exposures or soil series on the basis of the two dominant species at the 5 per cent or 1 per cent levels of significance. The highest mean importance value for post oak and the lowest mean importance value for blackjack oak occurred on this western exposure as compared to other upland sites.

Mean importance values for post oak and blackjack oak on this slope exposure are significantly different from all bottomland soil series sampled. The mean importance value of post oak is significantly different from all bottomland soil series at the 1 per cent level of significance. Blackjack oak has a mean importance value significantly different from the Port soil series at the 5 per cent level of significance and at the 1 per cent level of significance from the Yahola soil series and Alluvial soil complex.

Mean density of saplings decreased to 165.0 per acre for post oak and 33.5 per acre for blackjack oak. This indicates a more xeric environment than is present on any of the other slope exposures or soil series. Blackjack oak saplings are highly clumped, having a mean frequency of 17.5 per cent, but post oak saplings are much more dispersed with a mean frequency of 60.5 per cent.

Konawa Soil Series

Of the twelve species sampled on the Konawa soil series, only two occur as dominants. Post oak was dominant on all five sites, and blackjack oak was dominant on three sites. The mean values of post oak were importance value of 167.2, basal area of 43.0 square feet per acre, density of 163.2 trees per acre, and frequency of 70.0 per cent.

Under this more mesic environment, blackjack oak increased in importance with mean values of 92.8, 24.4 square feet per acre, 80.5 trees per acre, and 43.0 per cent frequency. Mean basal area and mean density for all species of this soil series were 74.7 square feet per acre and 275.0 trees per acre.

Bitternut hickory occurred on all five sites sampled while redbud (Cercis canadensis) and red mulberry (Morus rubra) occurred on four of the five sites. These species are considered to be less drought resistant, which would indicate a more mesic soil series than that of the Stephenville-Darnell soil complex.

The Konawa soil series cannot be distinguished from the other upland slope exposures within the Stephenville-Darnell soil complex on the basis of mean importance values for post oak and blackjack oak at the 5 per cent or 1 per cent levels of significance. Its mean values are more similar to the eastern slope than either the level or western slopes.

Mean importance values of post oak and blackjack oak were significantly different from those of all bottomland soil series at the 1 per cent level of significance.

In saplings post oak had a density of 172.6 per acre and a frequency of 59.5 per cent. Blackjack oak had a density of 39.1 saplings per acre and 17.5 per cent frequency. Using sapling density as an estimate of future tree composition on the soil series, blackjack oak will decrease in importance with a corresponding increase in post oak.

Port Soil Series

Of the 24 species that occurred on the Port soil series, only two were dominant. Hackberry was dominant on all five sites sampled with mean importance value of 97.8, mean basal area of 19.4 square feet per acre, mean density of 61.5 trees per acre, and mean frequency of 39 per cent. American elm occurred as a dominant on two of the five areas. Mean values for this species were an importance value of 70.9, a basal area of 21.5 square feet per acre, a density of 34.5 trees per acre, and a frequency of 23.5 per cent. Mean basal area and mean density for all species of this soil series were 84.4 square feet per acre and 157.0 trees per acre.

This soil series can be distinguished from all upland soil series at the 1 per cent level of significance based on mean importance value of hackberry and at the 1 per cent level of significance based on the mean importance value of black walnut (Tables X and XI). The mean importance value of hackberry for this soil series is significantly greater at the 5 per cent level than for the Alluvial soil complex and significantly greater at the 1 per cent level than for the Yahola soil series. Bur oak had a mean importance value large enough to be significantly different at the 1 per cent level from the level slope of the Stephenville-Darnell soil complex (Table XII).

Although black walnut and bur oak were not dominant on any sites of this soil series, their mean values were large enough to warrant a test for significance. Black walnut had a mean importance value of 22.9, a mean basal area of 8.6 square feet per acre, a mean density of 9.0 trees per acre, and a mean frequency of 7.0 per cent. The mean values of bur oak were 23.2, 10.4 square feet per acre, 7.5 trees per acre, and 7.5 per cent.

TABLE X.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF CELTIS SPP.

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	5.1 ± 2.5						
S-D(L)	4	0.4 ± 0.2						
S-D(W)	5	5.1 ± 0.8						
K	5	2.3 ± 1.4						
P	5	97.8 ± 9.6	**	**	**	**		
A	5	45.2 ± 15.7		**			*	
Y	4	30.9 ± 15.4		**			**	

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

Hackberry is by far the leading species in regeneration of this soil series with a mean density of 72 saplings per acre and a mean frequency of 38.0 per cent. Next is red elm (Ulmus rubra) with a mean density of 12.0 saplings per acre and American elm with 11.5 saplings per acre. Boxelder (Acer Negundo) and western soapberry (Sapindus Drummondii) also occur and had mean densities of 10.5 saplings per acre and 11.0 saplings per acre respectively.

TABLE XI.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED

ON MEAN IMPORTANCE VALUE OF JUGLANS NIGRA

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	0.0 ± 0.0						
S-D(L)	4	0.0 ± 0.0						
S-D(W)	5	0.0 ± 0.0						
K	5	0.0 ± 0.0						
P	5	22.9 ± 6.1	*	*	*	*		
A	5	5.6 ± 4.9						
Y	4	17.2 ± 11.1						

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

Alluvial Soil Complex

Twenty-two species occurred on the Alluvial soil complex with four occurring as dominants on at least one of the five sites. American elm was dominant on four of the five sites with mean values for all sites of 85.6 i.v., 25.3 square feet per acre of basal area, 52.6 trees per acre density, and 28.6 per cent frequency. Hackberry decreased in importance occurring as a dominant on only one site. Mean values for this species were an importance value of 45.2, a basal area of 12.8 square feet per acre, a density of 32.9 trees per acre, and a frequency of 21.8 per cent. Bur oak was dominant on one site in the southwestern part of the county. Mean values were an importance value of 27.8, a basal area of 10.5 square feet per acre, a density of 7.0 trees per acre, a frequency of 5.5 per cent. Ash had mean values of 45.6, 15.7 square feet per acre, 62.8 trees per acre, and 19.8 per cent respectively, due mainly to its abundance on one site of which it was a dominant. Mean basal area and mean density for all species of this soil complex were 82 square feet per acre and 207.2 trees per acre.

TABLE XII.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF QUERCUS MACROCARPA

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	0.0 ± 0.0						
S-D(L)	4	0.0 ± 0.0						
S-D(W)	5	0.0 ± 0.0						
K	5	0.0 ± 0.0						
P	5	23.0 ± 9.8	**					
A	5	27.7 ± 17.7	*					
Y	4	8.5 ± 5.2						

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

This soil complex is distinguishable at the 1 per cent level of significance from all upland soil series on the mean importance value of American elm (Table XIII). It is significantly different from the level exposure of the Stephenville-Darnell soil complex at the 5 per cent level based on the mean importance value of bur oak and at the 1 per cent level for mean importance value of hackberry. The mean importance values for ash were not found to be significantly different.

TABLE XIII.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF *ULMUS AMERICANA*

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	1.0 ± 0.7						
S-D(L)	4	0.4 ± 0.4						
S-D(W)	5	0.6 ± 0.5						
K	5	0.3 ± 0.1						
P	5	70.9 ± 11.5	**	**	**	**		
A	5	85.6 ± 12.5	**	**	**	**		
Y	4	84.6 ± 6.8	**	**	**	**		

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

American elm had a mean density of 45.9 saplings per acre and a mean frequency of 15.6 per cent. Next in mean density was hackberry with 16.8 saplings per acre. Redbud, ash, Kentucky coffeetree (*Gymnocladus dioica*) and western soapberry also occurred, with mean densities greater than 10 saplings per acre.

Yahola Soil Series

Three species occurred as dominants on at least one of the four sites sampled out of the twenty-four species found on the Yahola soil series. American elm was most important with a mean importance value of 84.6, a mean basal area of 22.6 square feet per acre, a mean density of 23.4 trees per acre, and a mean frequency of 15.2 per cent. This species was dominant on three of the four sites sampled. Hackberry was dominant on one site with mean values of an importance value of 38.6, a basal area of 3.9 square feet per acre, a density of 13.9, and a frequency of 12.6 per cent. Pecan (Carya illinoensis) was found on only one site with mean importance value of 20.2, a mean basal area of 3.1 square feet per acre, a mean density of 7.5 trees per acre, and a mean frequency of 6.2 per cent. This species was not tested for significance since it was on one site only. Mean basal area and mean density for all species of this soil series were 57.0 square feet per acre and 94.6 trees per acre.

Eastern cottonwood was not dominant on any of the four sites but was third in importance on this soil series. Mean values were an importance value of 22.5, a basal area of 8.4 square feet per acre, a density of 3.8 trees per acre, and a frequency of 2.6 per cent.

Yahola soil series can be distinguished from other soil series sampled by the mean importance values of American elm, hackberry, and eastern cottonwood (Table XIV). The mean importance value of American elm is significantly different from the mean values of all upland soil series and slope exposures at the 1 per cent level of significance. The soil series is significantly different from the level exposure of the Stephenville-Darnell soil complex at the 1 per cent level on the basis of the mean importance value of hackberry. The mean importance value of eastern cottonwood on this soil series is significantly different from all other soil series at the 1 per cent level of significance with the exception of the Port soil series, which is significant at the 5 per cent level.

TABLE XIV.

SIGNIFICANCE FOR VARIOUS SOIL SERIES SAMPLED BASED ON MEAN IMPORTANCE VALUE OF *POPULUS DELTOIDES*

Soil Type	N#	Mean Importance Value ± Standard Error	S-D(E)	S-D(L)	S-D(W)	K	P	A
S-D(E)	5	0.0 ± 0.0						
S-D(L)	4	0.0 ± 0.0						
S-D(W)	5	0.0 ± 0.0						
K	5	0.0 ± 0.0						
P	5	4.2 ± 2.4						
A	5	0.9 ± 0.6						
Y	4	22.5 ± 4.4	**	**	**	**	*	**

* Significantly Different at 5% Level
** Significantly Different at 1% Level
N# Number of Sites

Western soapberry was most abundant in saplings with a density of 20.6 saplings per acre and a frequency of 9.5 per cent. Next in importance was hackberry with 13.5 saplings per acre. American elm, eastern redcedar (*Juniperus virginiana*) and boxelder had mean densities greater than 5 saplings per acre.

CHAPTER V.

CONCLUSIONS

The upland soil series were dominated by post oak and blackjack oak. Although there was no significant difference between these soil series based on mean importance values of these two species, there was a general increase of post oak from the Konawa soil series to the western exposure of the Stephenville-Darnell soil complex with a corresponding decrease in blackjack oak. High mean values for blackjack oak on the eastern exposure of the Stephenville-Darnell soil complex were partially due to a high incidence on one of the five sites sampled.

From general trends in the data, it seems that post oak is more drought resistant than blackjack oak. When total basal area per acre for all species was compared with mean importance values for the above two species on the eastern and western exposures, post oak increased in importance on the drier western exposures while blackjack oak decreased in importance.

Based on mean importance values of post oak and blackjack oak, the upland soil series were significantly different from the bottomland soil series. These two species occurred to a very limited extent on the Alluvial soil complex and Yahola soil series. Competition from other species on these more mesic sites was probably the major limiting factor.

Bitternut hickory was found on three of the five sites sampled on the western exposure of the Stephenville-Darnell soil complex, and on one site the level exposure, but was entirely absent from the eastern exposure. When the more mesic Konawa soil series was sampled, it was found to be present on all five sites. Since this was not an autecological study, this unusual distribution was not pursued. A thorough study of the microclimatic tolerances of this species may resolve the problem.

If saplings are used as an index for future stand composition on the upland soil series, there appears to be no succession of species taking place. Ratios in saplings per acre of post oak and blackjack oak were very similar to ratios of trees per acre for the same two species. There was an increase in density of saplings for bitternut hickory compared to density of trees on the Konawa soil series and the level and western exposure of the Stephenville-Darnell soil complex. This increase is probably not large enough to affect the future stand composition of these soils and is probably due to the high rainfall and good growing years Payne County has experienced since 1957.

The bottomland soil series are dominated by hackberry and American elm with pecan, bur oak, and ash occurring as major dominants on one site each. Of these species, American elm was the most important. This species had a larger mean basal area per acre than any other species on all bottomland soil series, but a smaller mean importance value on the Port soil series than did hackberry. This large mean importance value for hackberry was due to an abundance of small-diameter trees well distributed over the sites, which gave this species a much higher density and frequency than for the larger, more widely spaced American elm trees.

American elm is considered to be a climax species on bottomland soils. The significant occurrence of this species on all bottomland soil series sampled indicates they may be nearing a climax condition, although other species indicate many sites sampled are still in successional stages.

Hackberry, found to be significant on the Port soil series, is classed as a tolerant to intolerant species (Fowells, 1965). It usually persists to a sub-climax stage although its exact role in succession is questionable because of its wide distribution. Western hackberry (Celtis occidentalis) and sugarberry (Celtis laevigata) hybridize readily. For this reason they were sampled as one species.

The immaturity of the Yahola soil series is indicated by the significant mean importance value of eastern cottonwood. This species is intolerant and is not found to be abundant in climax communities. It occurred on this soil series in a narrow band directly adjacent to the Cimarron River with the exception of the western-most site sampled where it was scattered throughout.

Pecan was a major dominant on one site of the Yahola soil series but was not sampled on any of the other sites. This is further evidence of the immaturity of this soil type since the pecan is also classed as an intolerant species.

The high mean values of ash on the Alluvial soil complex were primarily due to one site, on which this species occurred as a major dominant. Ash is considered an early transitional species, intolerant to tolerant, and declines in importance as the stable climax is reached (Fowells, 1965). Green ash (Fraxinus pennsylvanica) and white ash (Fraxinus americana) are very difficult to distinguish vegetatively. Therefore, they were sampled as one species.

Bur oak was a major dominant on the western most site of the Alluvial soil complex. This species increased in importance on the western sites of both the Alluvial soil complex and the Port soil series, but was more evenly distributed over the Port in other areas of the county.

If saplings are used as an indication of future species composition of the bottomland soils, hackberry appears to be increasing on the Port soil series, while American elm is increasing on the Alluvial soil complex. No one species dominated the saplings in number and distribution on the Yahola soil series.

In retrospect, the forests of Payne County can be divided, on the basis of edaphic and topographic factors, into four units, the post oak-blackjack oak type, the American elm-hackberry type, the American elm-eastern cottonwood type, and the American elm type. Of these the upland soil series may be considered as climax, whereas the Alluvial and Port soil series are approaching stability, and the Yahola soil series may be considered a somewhat early successional stage.

CHAPTER VI.

SUMMARY

This study was done to determine whether forested communities are significantly different on five soil series and three slope exposures in the area of Payne County, Oklahoma. The following results and conclusions were drawn from the information gained from this work:

1. Post oak and blackjack oak dominated all upland soil series. Although not significant, there was a general increase in post oak from the eastern to the western exposures of the Stephenville-Darnell soil complex with a corresponding decrease in blackjack oak.
2. Basal area per acre for all species was lowest on the western exposure of the Stephenville-Darnell soil complex and highest on the Konawa soil series for the upland soil series.
3. Based on mean importance values of post oak and blackjack oak, all exposures of the Stephenville-Darnell soil complex and the Konawa soil series were significantly different from all bottomland soil series at the 1 per cent level.
4. If saplings are used as an indication of future species composition, there appears to be no succession of species taking place on upland soil series. This would indicate that the forest communities of the Stephenville-Darnell and Konawa soil series

are at climax.

5. The Port soil series can be distinguished from all other soil series by the significant occurrence of hackberry. American elm was more important in basal area than was hackberry on this soil series, however. This soil series can be distinguished from all upland soil series based on mean importance values of American elm and black walnut.
6. The Alluvial soil complex was dominated by American elm, although two other species occurred as major dominants on one site each. Bur oak was a major dominant on the western most site and ash occurred as a major dominant on one other site. This soil series is significantly distinguishable from all upland soil series based on the mean importance value of American elm.
7. Eastern cottonwood was significant in occurrence on the immature Yahola soil series. This soil series can also be distinguished from all upland soil series on the significant occurrence of American elm. Pecan was a major dominant on one site but was absent from all others.
8. If saplings are used as an indication of future species composition of the bottomland soils, hackberry appears to be increasing on the Port soil series, while American elm is increasing on the Alluvial soil complex. No one species dominated the saplings in number and distribution on the Yahola soil series. Saplings and the occurrence of tree species such as eastern cottonwood and pecan on the Yahola soil series, ash on the Alluvial soil complex, and hackberry on the Port soil series indicate these soil series to still be in successional stages; however, the significant

occurrence of American elm indicates they are nearing climax.

9. The forests of Payne County can be divided, on the basis of edaphic and topographic factors, into four units; the post oak-blackjack oak type, the American elm-hackberry type, the American elm-cottonwood type, and the American elm type.

A SELECTED BIBLIOGRAPHY

Bruner, W. E. 1931. The vegetation of Oklahoma. Ecological Monographs 1: 99-188.

Buck, Paul. 1964. Relationships of the woody vegetation of the Wichita Mountains Wildlife Refuge to geological formations and soil types. Ecology 45(2): 336-344.

Climatography of the United States. 1951-1960. Series 86: 21-30.

Cobb, W. B. and H. W. Hawker. 1918. Soil survey of Payne County, Oklahoma. U. S. Department of Agriculture, Bureau of Soils.

Culver, James R. 1966. Personal communication.

Curtis, J. T. and R. P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology 32(3): 476-496.

Diebold, C. H. 1935. Some relationships between soil type and forest site quality. Ecology 16: 640-647.

Dyksterhuis, E. J. 1948. The vegetation of the western cross timbers. Ecological Monographs 18: 325-376.

Fowells, H. A. 1965. Silvics of forest trees of the United States. U. S. Department of Agriculture, Forest Service.

National Cooperative Soil Survey, Established Series. U. S. A.

Rice, E. L. 1965. Bottomland forests of north-central Oklahoma. Ecology 40: 708-713.

Rice, E. L. and W. T. Penfound. 1959. The upland forests of Oklahoma. Ecology 40: 593-608.

Rice, E. L. and W. T. Penfound. 1955. An evaluation of the variable-radius and paired-tree methods in the blackjack-post oak forest. Ecology 36(2): 315-320.

Steel, Robert G. D. and James H. Torrie. 1960. Principles and procedures of statistics. McGraw-Hill Book Company, Inc., New York.

Waterfall, U. T. 1960. Keys to the Flora of Oklahoma. Oklahoma State University, Stillwater, Oklahoma.

Weaver, John E. and Frederic E. Clements. 1938. Plant Ecology. McGraw-Hill Book Company, Inc., New York.

Whittaker, R. H. 1960. Vegetation of the Siskiyou Mountains, Oregon and California. Ecological Monographs 30: 279-338.

APPENDIX A.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES ON INDIVIDUAL SITES OF THE EASTERN EXPOSURE OF THE STEPHENVILLE-DARNELL SOIL COMPLEX

Species		Site 1	Site 2	Site 3	Site 4	Site 5
Bumelia lanuginosa	BA	-	-	-	0.8	0.4
	DT	2.0	15.0	-	5.0	-
	FT	2.0	5.0	-	5.0	-
Celtis spp.	BA	1.3	-	1.2	1.3	0.4
	DT	5.0	-	2.0	12.0	-
	FT	5.0	-	2.0	8.0	-
Quercus marilandica	BA	4.8	20.8	40.5	14.3	17.8
	DT	40.0	85.0	198.0	75.0	25.0
	FT	22.0	45.0	70.0	32.0	20.0
Quercus Muehlenbergii	BA	-	-	-	-	-
	DT	-	2.0	5.0	-	-
	FT	-	2.0	5.0	-	-
Quercus stellata	BA	54.8	43.8	25.0	48.0	47.0
	DT	320.0	140.0	62.0	390.0	172.0
	FT	82.0	65.0	28.0	75.0	64.0
Ulmus americana	BA	-	-	0.2	0.3	0.7
	DT	-	-	-	-	-
	FT	-	-	-	-	-
Others	BA	-	-	0.8	0.8	1.9
	DT	-	-	2.0	10.0	6.0
	FT	-	-	2.0	8.0	6.0

APPENDIX B.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES ON INDIVIDUAL SITES OF THE LEVEL EXPOSURE OF THE STEPHENVILLE-DARNELL SOIL COMPLEX

Species		Site 1	Site 2	Site 3	Site 4
Bumelia lanuginosa	BA	-	0.8	0.2	-
	DT	18.0	5.0	10.0	-
	FT	8.0	5.0	10.0	-
Carya cordiformis	BA	-	-	1.0	-
	DT	-	-	15.0	-
	FT	-	-	12.5	-
Quercus marilandica	BA	22.0	20.8	10.5	6.2
	DT	93.0	115.0	42.0	10.0
	FT	50.0	55.0	30.0	10.0
Quercus stellata	BA	45.0	29.8	51.0	36.5
	DT	210.0	248.0	305.0	180.0
	FT	72.0	58.0	78.0	72.0
Others	BA	1.0	0.3	2.5	1.0
	DT	2.0	5.0	-	-
	FT	2.0	2.0	-	-

APPENDIX C.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES ON INDIVIDUAL SITES OF THE WESTERN EXPOSURE OF THE STEPHENVILLE-DARNELL SOIL COMPLEX

Species		Site 1	Site 2	Site 3	Site 4	Site 5
Bumelia lanuginosa	BA	0.3	0.3	1.3	0.5	-
	DT	-	-	2.0	-	2.0
	FT	-	-	2.0	-	2.0
Carya cordiformis	BA	3.5	-	-	3.8	2.8
	DT	8.0	-	-	10.0	8.0
	FT	8.0	-	-	8.0	5.0
Quercus marilandica	BA	3.8	15.5	5.0	0.8	14.5
	DT	25.0	92.0	22.0	8.0	65.0
	FT	20.0	40.0	20.0	8.0	40.0
Quercus stellata	BA	37.8	38.0	54.2	54.0	41.0
	DT	180.0	248.0	220.0	238.0	222.0
	FT	78.0	62.0	80.0	72.0	75.0
Others	BA	-	0.3	0.8	3.5	1.0
	DT	-	2.0	2.0	20.0	2.0
	FT	-	2.0	2.0	15.0	2.0

APPENDIX D.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES

ON INDIVIDUAL SITES OF THE KONAWA SOIL SERIES

Species		Site 1	Site 2	Site 3	Site 4	Site 5
Carya cordiformis	BA	1.8	2.2	3.5	10.5	2.8
	DT	2.0	18.0	5.0	40.0	15.0
	FT	2.0	8.0	5.0	22.0	12.0
Quercus marilandica	BA	28.0	39.2	39.0	12.0	3.5
	DT	110.0	125.0	105.0	55.0	8.0
	FT	50.0	65.0	60.0	35.0	5.0
Quercus stellata	BA	33.5	19.8	40.0	51.5	60.0
	DT	102.0	102.0	142.0	228.0	24.0
	FT	62.0	58.0	62.0	80.0	86.0
Others	BA	2.5	4.0	4.8	1.0	0.8
	DT	15.0	15.0	20.0	8.0	5.0
	FT	12.0	15.0	18.0	8.0	5.0

APPENDIX E.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES

ON INDIVIDUAL SITES OF THE PORT SOIL SERIES

Species		Site 1	Site 2	Site 3	Site 4	Site 5
Acer Negundo	BA	0.2	2.0	2.5	4.0	4.0
	DT	5.0	5.0	5.0	5.0	8.0
	FT	5.0	2.0	5.0	5.0	8.0
Carya illinoensis	BA	-	12.5	8.0	3.5	-
	DT	-	-	-	2.0	-
	FT	-	-	-	2.0	-
Celtis spp.	BA	34.0	12.8	14.8	13.2	22.2
	DT	70.0	98.0	40.0	40.0	60.0
	FT	55.0	35.0	38.0	28.0	40.0
Fraxinus spp.	BA	2.5	4.5	15.0	1.2	0.5
	DT	5.0	2.0	30.0	2.0	2.0
	FT	5.0	2.0	18.0	2.0	2.0
Gymnocladus dioica	BA	-	-	2.2	0.8	2.8
	DT	-	-	2.0	-	8.0
	FT	-	-	2.0	-	5.0
Juglans nigra	BA	1.5	10.5	15.8	9.5	5.8
	DT	10.0	5.0	18.0	10.0	2.0
	FT	8.0	5.0	15.0	5.0	2.0
Morus rubra	BA	1.0	1.0	1.5	1.8	1.0
	DT	18.0	2.0	12.0	2.0	-
	FT	8.0	2.0	10.0	2.0	-
Populus deltoides	BA	0.8	2.8	-	7.2	2.2
	DT	-	-	-	2.0	-
	FT	-	-	-	2.0	-
Quercus macrocarpa	BA	24.0	8.0	-	12.5	7.8
	DT	25.0	2.0	-	8.0	2.0
	FT	25.0	2.0	-	8.0	2.0
Others	BA	7.6	3.9	0.2	4.2	19.8
	DT	48.0	15.0	8.0	2.5	35.0
	FT	70.0	12.0	8.0	2.5	28.0

APPENDIX F.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES

ON INDIVIDUAL SITES OF THE ALLUVIAL SOIL COMPLEX

Species		Site 1	Site 2	Site 3	Site 4	Site 5
Acer	BA	-	-	5.8	-	0.4
Negundo	DT	-	-	10.0	-	-
	FT	-	-	10.0	-	-
Bumelia	BA	3.2	1.0	-	-	-
lanuginosa	DT	10.0	2.0	-	-	-
	FT	10.0	2.0	-	-	-
Celtis	BA	-	3.8	21.5	23.5	15.4
spp.	DT	-	5.0	50.0	68.0	42.0
	FT	-	5.0	30.0	44.0	29.0
Fraxinus	BA	-	1.8	16.2	58.0	2.5
spp.	DT	-	5.0	12.0	292.0	4.0
	FT	-	5.0	12.0	78.0	4.0
Juglans	BA	-	2.2	-	-	5.4
nigra	DT	-	-	-	-	13.0
	FT	-	-	-	-	13.0
Juniperus	BA	5.8	0.2	-	-	-
virginiana	DT	15.0	-	-	-	-
	FT	12.0	-	-	-	-
Morus	BA	-	1.5	4.8	0.5	3.3
rubra	DT	-	8.0	-	5.0	29.0
	FT	-	5.0	-	5.0	13.0
Populus	BA	2.2	0.2	-	-	0.8
deltoides	DT	-	-	-	-	-
	FT	-	-	-	-	-
Quercus	BA	33.3	19.2	-	-	-
macrocarpa	DT	20.0	15.0	-	-	-
	FT	15.0	12.0	-	-	-
Quercus	BA	-	9.5	-	-	-
Muehlenbergii	DT	-	18.0	-	-	-
	FT	-	10.0	-	-	-
Quercus	BA	4.2	10.2	-	-	-
stellata	DT	2.0	15.0	-	-	-
	FT	2.0	8.0	-	-	-
Sapindus	BA	-	0.2	6.8	-	-
Drummondii	DT	-	2.0	38.0	-	-
	FT	-	2.0	18.0	-	-
Ulmus	BA	20.0	17.0	37.2	13.0	39.2
americana	DT	25.0	38.0	52.0	72.0	76.0
	FT	20.0	22.0	30.0	32.0	38.0
	BA	2.5	4.6	2.0	3.8	0.8
Others	DT	25.0	16.0	20.0	5.0	-
	FT	18.0	13.0	15.0	5.0	-

APPENDIX G.

BASAL AREA (BA), DENSITY (DT), AND FREQUENCY (FT) OF TREES

ON INDIVIDUAL SITES OF THE YAHOLA SOIL SERIES

Species		Site 1	Site 2	Site 3	Site 4
Bumelia lanuginosa	BA	2.0	0.2	0.2	-
	DT	2.0	2.0	-	-
	FT	2.0	2.0	-	-
Carya illinoensis	BA	-	12.5	-	-
	DT	-	30.0	-	-
	FT	-	25.0	-	-
Celtis spp.	BA	7.2	6.2	0.2	1.9
	DT	25.0	22.0	2.0	6.0
	FT	20.0	18.0	2.0	6.0
Cercis canadensis	BA	-	0.5	-	2.5
	DT	-	-	-	20.0
	FT	-	-	-	14.0
Fraxinus spp.	BA	0.2	-	2.0	-
	DT	-	-	8.0	-
	FT	-	-	2.0	-
Juglans nigra	BA	-	-	6.2	5.3
	DT	-	-	15.0	8.0
	FT	-	-	10.0	6.0
Populus deltoides	BA	9.0	7.5	12.0	5.0
	DT	2.0	-	10.0	3.0
	FT	2.0	-	5.0	3.0
Quercus macrocarpa	BA	-	5.0	2.8	-
	DT	-	5.0	8.0	-
	FT	-	5.0	2.0	-
Quercus Muehlenbergii	BA	-	-	6.0	5.6
	DT	-	-	2.0	6.0
	FT	-	-	2.0	6.0
Quercus Shumardii	BA	-	-	7.8	-
	DT	-	-	2.0	-
	FT	-	-	2.0	-
Sapindus Drummondii	BA	0.2	-	0.8	4.4
	DT	8.0	-	2.0	22.0
	FT	2.0	-	2.0	8.0
Ulmus americana	BA	20.8	18.0	30.2	21.4
	DT	20.0	32.0	30.0	11.0
	FT	10.0	25.0	18.0	8.0
Others	BA	4.2	2.5	7.5	6.2
	DT	10.0	10.0	15.0	11.0
	FT	8.0	8.0	15.0	8.0

VITA

George Ralph Parker

Candidate for the Degree of

Master of Science

Thesis: EDAPHIC AND TOPOGRAPHIC EFFECTS ON FOREST COMMUNITIES OF PAYNE COUNTY, OKLAHOMA

Major Field: Botany and Plant Pathology

Biographical:

Personal Data: Born in Tulsa, Oklahoma, September 16, 1942, the son of Ralph B. and Gladys Mae Parker. Married Mary Lee Williams, September 4, 1965.

Education: Attended grade school in Sand Springs, Oklahoma; graduated from Charles Page High School, Sand Springs, Oklahoma in 1960; received the Bachelor of Science degree from Oklahoma State University, with a major in Forestry, in May, 1964; completed requirements for the Master of Science degree in July, 1967.

Professional experience: Served as graduate teaching assistant in Botany at Oklahoma State University, 1965 to 1967.

Professional organizations: Member of Society of American Foresters, Phi Sigma Society, and Sigma Xi.