A FLORISTIC STUDY OF THE VASCULAR PLANTS OF THE GYPSUM HILLS AND REDBED PLAINS AREA OF SOUTHWESTERN OKLAHOMA

By

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1974

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
December, 1975

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PREFACE

This study includes a list of the vascular plants and other information on the geology, soils, and climate of the Gypsum Hills and Redbed Plains region in southwestern Oklahoma which includes Harmon, Jackson, and Greer counties. The list is by necessity not complete. Only one collecting season is covered in the study, and many years of work would be necessary to obtain a near complete list.

I would like to express appreciation to the members of my committee, Dr. J. K McPherson and Dr. J. R. Estes for their advisement and assistance during the course of study.

Thanks is given to my colleagues who made collecting trips with me into the study area.

Thanks is given to my parents, Mr. and Mrs. R. R. Barber for their continued support during the completion of my program.

Special thanks is given to my advisor, Dr. Ronald J. Tyrl for his continued direction and encouragement throughout the course of this study.

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CHAPTER I

INTRODUCTION

Gypsum outcrops and soils often support a distinctive flora. These endemic species presumably evolved in response to the rigorous conditions of high calcium sulfate content, drought, etc. Turner (1973) reports numerous new gypsophilous species from Mexico. In southwestern Oklahoma gypsum deposits are quite extensive and Waterfall (1950) listed new additions to the Oklahoma flora from Harmon and Jackson counties. This situation may parallel the well studied endemism on serpentine soils of California (Kruckeberg, 1951). Since gypsum often supports a distinctive group of plants and the southwestern part of the state has been seldom collected, it seems that the floristic components of the gypsum and redbed areas could prove to be very interesting, therefore a study of the flora of the region was undertaken. The objectives of the study were (1) to describe the floras of gypsum and redbed plains geomorphic provinces in southwestern Oklahoma, (2) to determine similarities and differences in plant taxa of the two provinces, (3) to determine if the gypsite region taxa are unique to it or are characteristic of the redbed plains and/or gypsum floras, and (4) to determine if there are differences in the floras of edaphic areas within the gypsum province.

The study area is located within Harmon, Jackson, and Greer

counties which are located in the southwestern corner of Oklahoma, the county seats being Hollis, Altus, and Mangum, respectively. The area is located approximately 55 miles northwest of Wichita Falls, Texas. The total land area is 1,272,256 acres or 1.988 square miles. Oklahoma Highway 9 near the Salt Fork of the Red River constitutes the northern boundary for the collection area, the Red River, the southern boundary, the North Fork of the Red River, the eastern boundary, and the Oklahoma-Texas state line, the western boundary (Figure 1).

Three east-west transects were established in order to include major soil types and the distinct geomorphic provinces. Locations of the collection sites established along the transects are listed below and are indicated by the circles on the map of Figure 1.

REDBEDS

R19W, T2N, Sec. 15
R19W, T2N, Sec. 17
R20W, T1S, Sec. 19
R20W, T1S, Sec. 20
R21W, T2N, Sec. 13
R22W, T2N, Sec. 13
R22W, T2N, Sec. 15
R23W, T2N, Sec. 3
R23W, T2N, Sec. 6
R23W, T5N, Sec. 18
R24W, T1S, Sec. 12
R26W, T4N, Sec. 3

GYPSUM

R22W, T1N, Sec. 33
R22W, T2N, Sec. 13
R23W, T1S, Sec. 21
R24W, T2N, Sec. 2
R24W, T2N, Sec. 6
R24W, T5N, Sec. 21
R25W, T1N, Sec. 7

SAND AREAS AND RIVER FLOODPLAINS

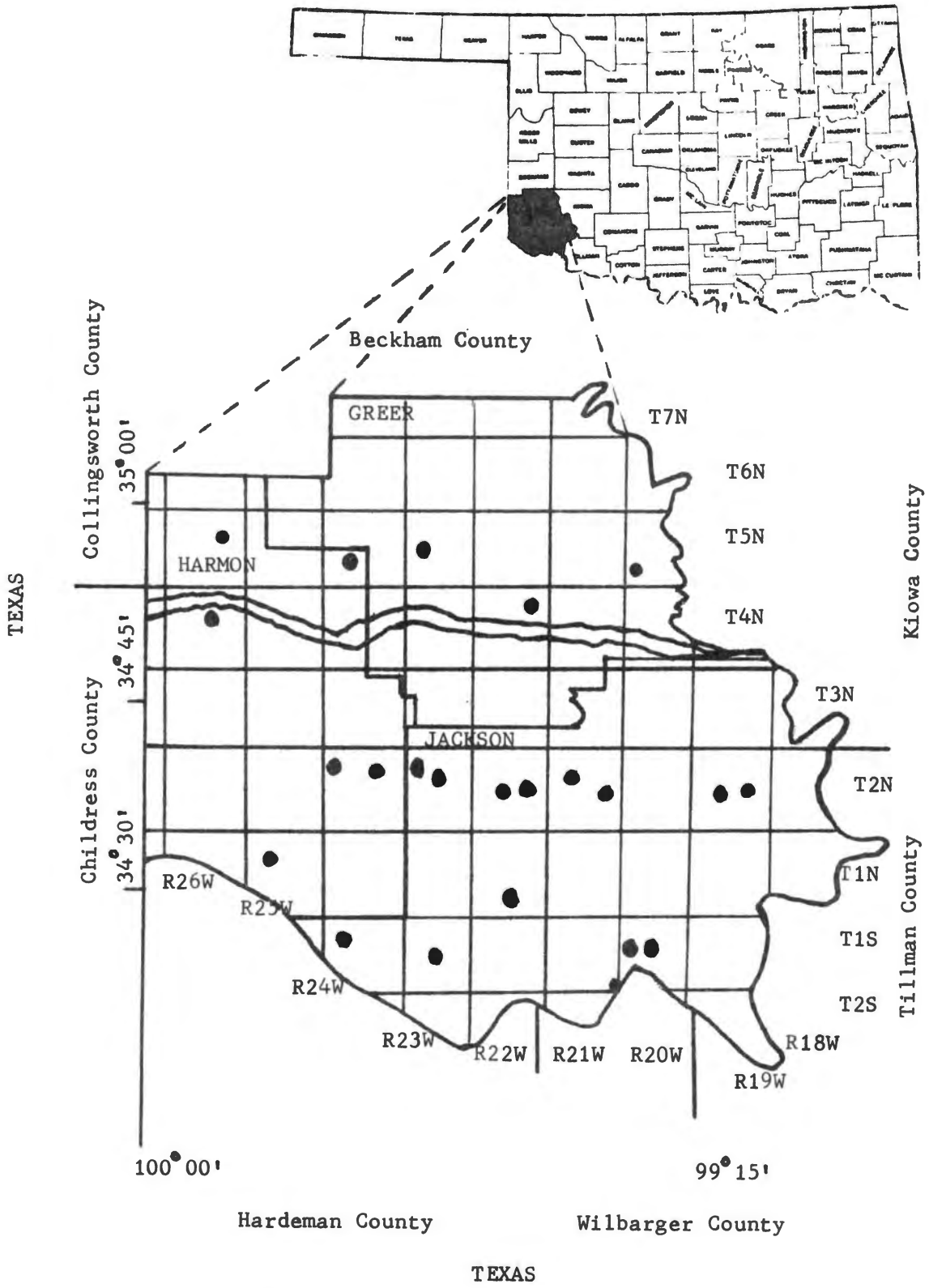


Figure 1. Location Map, Collection Sites Indicated by Solid Circles.

R20W, T2S, Sec. 11
R21W, T2N, Sec. 16
R22W, T4N, Sec. 1
R26W, T5N, Sec. 24

Collections were also made at other sites. Specimens of the vascular flora of the area were collected and identified. Collecting trips were made during the growing season starting April, 1975 and ending October, 1975. An attempt was made to collect the plants in different stages of flowering and fruiting. Voucher specimens were deposited in the Oklahoma State Herbarium (OKLA) and the Bebb Herbarium of the University of Oklahoma (OKL).

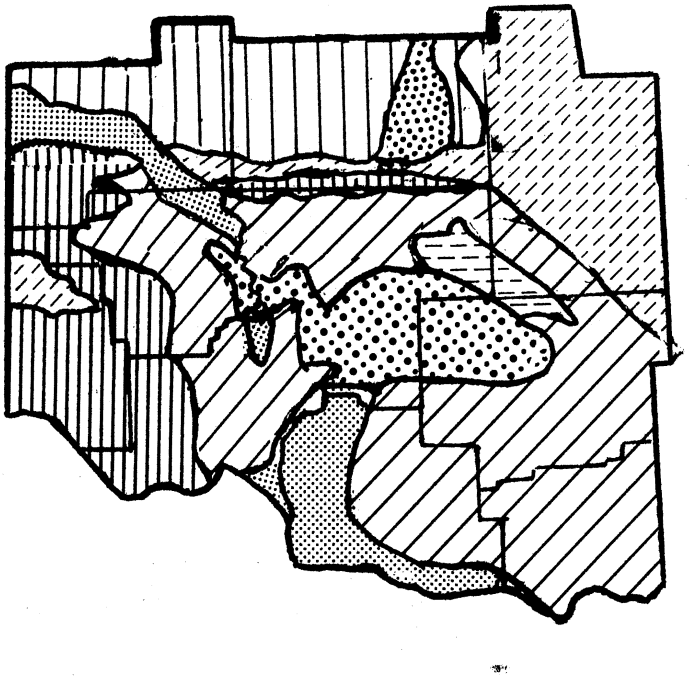
Geological and ecological considerations as well as a list of the 359 taxa are presented in subsequent chapters of this study.

CHAPTER II

GEOLOGY AND TOPOGRAPHY

Curtis and Ham (1972) describe twenty-six geomorphic provinces for Oklahoma. Of these twenty-six regions, three are found in the area of study: (1) the Mangum Gypsum Hills, (2) the Central Redbed Plains, and (3) the Western Sandstone Hills. The latter region is essentially composed of the same materials as the redbeds and is not discussed as a separate entity (Figure 2).

The most extensive of the geomorphic regions is the Central Redbed Plains area. These deposits were made during a time of sea withdrawal and extremely arid climates. The term redbeds applies to a series of brick-red shales and clays containing strata of other rock, occupying an area of approximately 50,000 square miles in southwestern Kansas, western Oklahoma, and northern Texas and extending westward to the Rocky Mountains. They are of Permian or Upper Carboniferous age, and rest directly above Pennsylvanian rocks to the east. In the west the redbeds have been covered by other formations of a later geologic age. West of the Salt Fork of the Red River are bluffs, mesas, and uplands of gypsum and sandstone that are intermingled with the redbeds. This area consists of red Permian clays and shales and has weathered into a gently rolling plain in which the hills seldom exceed 100 feet in height (Bruner, 1931). The area is well suited to the growth of grasses.



Western Sandstone Hills

Western Sand Dune Belts

Western Redbed Plains

Limestone Hills

Granite Mountain Region

Central Redbed Plains

Mangum Gypsum Hills

Weatherford Gypsum Hills

Figure 2. Geomorphic Provinces for Southwestern Oklahoma (Curtis and Ham, 1972).

The most extensive gypsum deposits in the United States, including the Oklahoma gypsum region, were laid in the Permian. The area extends almost uninterruptedly from central Iowa across Kansas, Oklahoma, and Texas. The most extensive gypsum deposits of this area are found in Oklahoma. The total amount of gypsum in the three counties is approximately 42,000,000,000 tons (Gould, 1910). There are three gypsum geomorphic provinces in Oklahoma: (1) the Cimarron Gypsum Hills (the Blaine Region of Gould, 1910), (2) the Weatherford Gypsum Hills, and (3) the Mangum Gypsum Hills (the Greer County Region of Gould, 1910). The Mangum Gypsum Hills are included within the study area. Stratification of the gypsum is erratic and the thickness of the formations varies a great deal. The gypsum does not form conspicuous hills, but appears on the surface in broken, not continous ledges. The area is delimited from the redbeds by escarpments which are especially steep in southwestern Oklahoma. Snider (1913) described intermediates of the gypsum and the redbed plains which are deposits of gypsiferous clay known as gypsite. These deposits usually lie in valleys or flats below the gypsum ledges. These are probably formed by water which percolates through gypsum to the valley floor and evaporates from the surface leaving gypsum in a fine crystalline form mixed with the clay of the valley floors. In the field it was impossible to distinguish these soils from mixed redbed, gypsum soils.

The occurence of copper minerals in Permian strata of western Oklahoma has been known from the time of Marcy's explorations in 1850. The copper is generally found in flowerpot shales which are in low relief areas. The shales are overlain by Duncan sandstone

and underlain by thin dolomites. These areas make up a relatively small part of the study area.

Clifton (1928) made a study of the geology of Harmon, Greer, Jackson, and Tillman counties. The surface exposures within the limits of the three counties belong, for the most part, to the Permian system. Along the northeastern limits of the area there is a line of pre-Cambrian exposures consisting of granite peaks and knobs. The Cimarron series is divided into three groups consisting of sandstone, shale, gypsum, and dolomite (Table I).

The Woodward group, exposed only at the surface in Harmon county, consists of two formations, the Whitehorse sandstone and the Dog Creek shale formations. The Dog Creek shale formation appears as a surface outcrop in T5N and extends as far east as R24W. The Whitehorse sandstone overlies the Dog Creek shales in some areas. Approximately the lower half of the formation is represented in the county.

The Blaine group, consisting only of the Blaine formation, is found in all three counties. The formation presents four or more series of discontinuous beds of gypsum and magnesium-calcium carbonate beds, with interbedded red clays and shales throughout the area it outcrops. Occasionally the gypsum beds have a tendency to erode locally in a series of outcrops. This formation covers the eastern portion of Harmon county, and the western portions of Jackson and Greer counties.

Three of the four formations of the Enid group are found in Jackson and Greer counties. None of the rocks of these formations are exposed at the surface in Harmon county. The Hennessey, Duncan,

TABLE I

GEOLOGIC FORMATIONS EXPOSED AT THE SURFACE
IN HARMON, GREER, AND JACKSON COUNTIES *

Series	Group	Formation
Cimarron	Woodward	Whitehorse Sandstone
		Dog Creek Shale
	Blaine	Blaine gypsums
	Enid	Chickasha
		Duncan
		Hennessey
		Garber

* From Clifton, 1928

and Chickasha are the formations. The Hennessey formation outcrops in the eastern part of Greer county and in the eastern and extreme southeastern sections of Jackson county. The Duncan and Chickasha formations appear as surface beds in the northern part of Greer county. In Jackson county the formation can be traced in an almost continuous line across the center of the county beginning near the town of Elmer.

Recent deposits consisting of sands, gravels, and alluvia border the streams in the area.

Harmon county is drained by the Red River and its tributaries, the principal of which are Lebos Creek, Salt Fork, and Elm Fork. Jackson county is also drained by the Red River and its tributaries, the North Fork, Salt Fork, and Gypsum Creek. Greer county is drained by Elm Fork, Salt Fork, and North Fork of the Red River. The drainage plain for all three counties slopes in a general southeast direction.

The intermingling of the gypsum and redbeds gives the area its characteristic topography. There is a considerable area having a relief dominated by low gypsum hills and escarpments. Otherwise, the topography is that of a level plain dissected by stream and erosion channels. The lowest elevation for the area is 1300 feet along the Red River in Jackson county and the highest elevation is 1900 feet in northeastern Harmon county.

CHAPTER III

SOILS

The soils of the three counties range from shallow to deep and are nearly level to steep. In general, however, the soils are moderately sloping. Soil series are described for only Jackson and Greer counties, while soil associations are described for all three counties. A series consists of all soils having like profiles and is named for a geographic feature near the area where the soil was first mapped. In contrast, soil associations consist of one or more major series and at least one minor series and are named for the major soils. These are much more useful to botanists because they cover large areas which are more readily compared and they often support distinctive vegetation types.

Table II enumerates the major soil series common to both Jackson and Greer counties. Tables III and IV list the other major soil series of Jackson and Greer counties, respectively. Since soil associations are more important to floristic botany, and the soil associations for each county are slightly different, each county will be dealt with separately.

Bailey and Graft (1961) describe eight soil associations for Jackson county. A brief description for each one is given below (Figure 3).

1. The Tillman-Hollister association covers about 40 percent

TABLE II

MAJOR SOIL SERIES COMMON TO JACKSON AND GREER COUNTIES

Series	Surface Layer	Factors of Formation		
		Parent Material	Vegetation	Slope
Enterprise	Very fine sandy loam	Very fine sand and silt; Quaternary	Short Grass Prairie	Nearly level to gently sloping
Hollister	Clay to Clay loam	Clayey Permian Red Beds	Short Grass Prairie	Nearly level
LaCasa	Clay loam	Clayey Permian Red Beds	Short Grass Prairie	Gently sloping
Miles	Fine sandy loam	Sandy earths of Quaternary deposits	Sandsage Grassland & Short Grass Prairie	Nearly level to undulating
Spur	Clay loam	Loamy alluvium from Permian Red Beds	Mixed Grass Prairie	Nearly level
Tillman	Clay loam	Clayey Permian Red Beds	Short Grass Prairie	Nearly level to gently sloping
Vernon	Clay loam or clay	Clayey Permian Red Beds	Short Grass Prairie	Gently sloping to steep
Weymouth	Clay loam	Calcareous Permian Red Beds	Short Grass Prairie	Gently to moderately sloping
Yahola	Loamy fine sand	Loamy to moderately sandy alluvium	Floodplain Woodland	Nearly level

TABLE III

MAJOR SOIL SERIES OF JACKSON COUNTY

Series	Surface Layer	Factors of Formation		
		Parent Material	Vegetation	Slope
Abilene	Clay Loam	Calcareous clayey sediments	Short Grass Prairie	Nearly level to gently sloping
Nobscot	Fine Sand	Sandy earths of Quaternary deposits	Sandsage Grassland	Gently to strongly sloping
Tipton	Loam	Loamy & silty alluvial Quaternary deposits	Short Grass Prairie	Nearly level & gently sloping
Tivoli	Fine Sand	Siliceous sands of Quaternary deposits	Sandsage Grassland	Billowy & Duney

TABLE IV

MAJOR SOIL SERIES OF GREER COUNTY

Series	Surface Layer	Factors of Formation		
		Parent Material	Vegetation	Slope
Lawton	Clay loam	Granitic Outwash	Mixed Grass Prairie	Nearly level to strongly sloping
Springer	Loamy fine sand	Old Alluvium reworked by wind	Tall Grass Prairie	Nearly level to strongly sloping

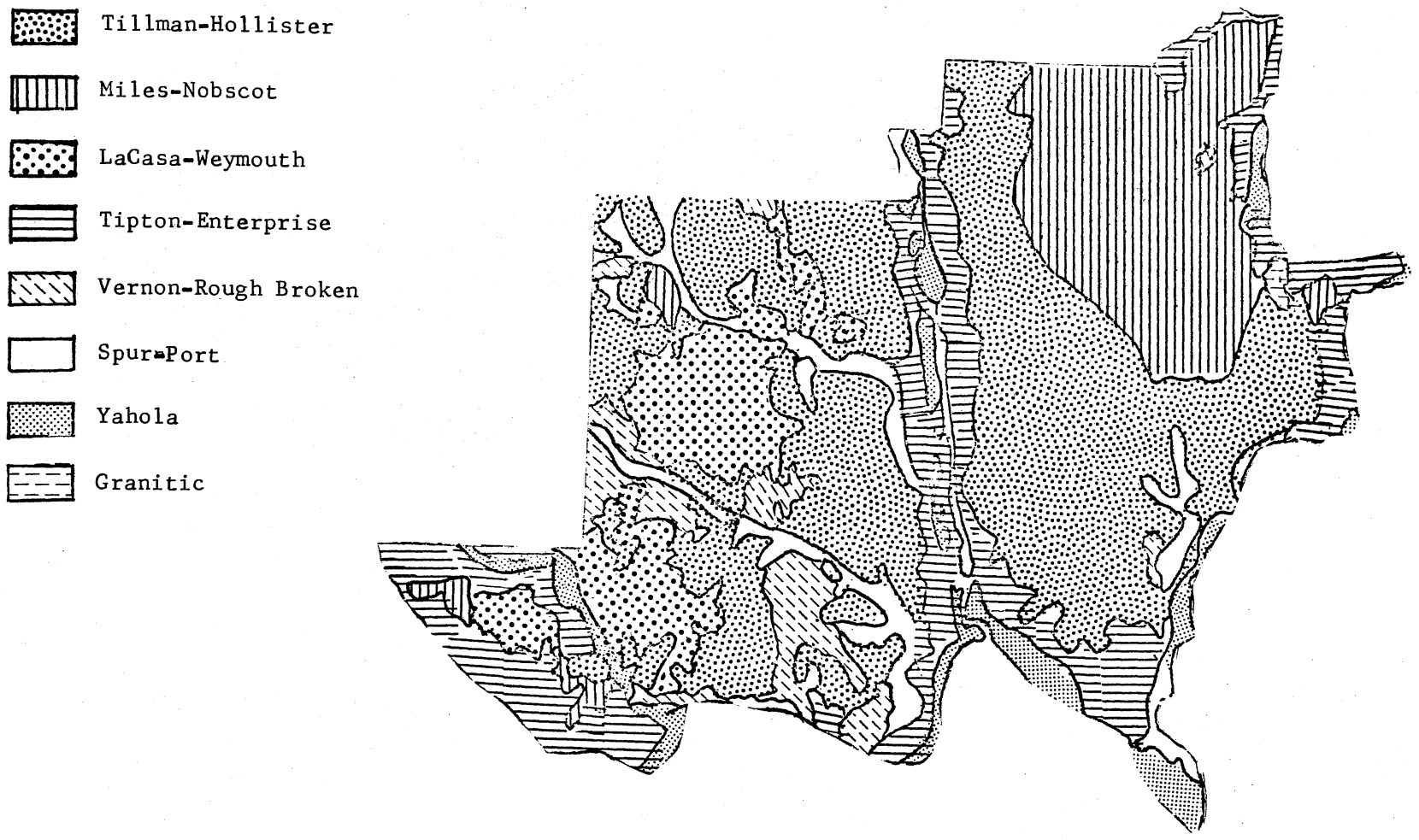


Figure 3. Soil Associations for Jackson County (Bailey and Graft, 1961).

of the county. This association is found on a large, broad plain that is nearly level to gently sloping. I is broken occasionally by small areas of rough and broken land. In the level areas are the Tillman, Hollister, and Abilene soils. The steep areas are composed of rough broken land. Most of these soils are cultivated and a great portion of the irrigated land in the county is in this association. Cotton, sorghum, and alfalfa are the principal irrigated crops of the association, and these crops and wheat are grown under dryland farming on this association.

2. The Miles-Nobscot association covers about 13 percent of the county. The chief soils in this association are moderately sandy to sandy, and the slope ranges from nearly level to steep. The Miles soils, the most extensive of the series, have a surface soil that is a fine sandy loam. They are nearly level to moderately sloping. The Nobscot soils are more sandy and more rolling than the Miles soils. The Miles soils of the association are best suited for cotton, grain sorghum, wheat, rye, and alfalfa. About two-thirds of the Nobscot soils are cultivated, and rye and grain sorghum are the crops grown. The rest of the association is used for rangeland.

3. The LaCasa-Weymouth association makes up about 10 percent of the land area of the county. The soils are gently to moderately sloping, but are broken occasionally by shallow, stony soils or rock outcrops. The LaCasa and Weymouth soils are gently sloping, and the steep soils are members of the Harmon and Vernon series. Most of these soils are cultivated with wheat being the major crop. Moisture conservation and erosion control are major problems of dryland agriculture on this association.

4. The Tipton-Enterprise-Tivoli association lies along the rivers and occupies 15 percent of the county. The soils are mostly level to gently sloping. The Enterprise and Tivoli soils are near the rivers and the Tipton soils occupy the terrace areas. The Tipton and Enterprise soils are similar and are formed in very fine sands and silts that are blown in from river channels. Tivoli soils consist of wind-drifted sands and are billowy or dunelike. The Tipton and Enterprise soils are fertile and crops are grown on them. Tivoli soil is used for range and is only fair to poor for grazing.

5. The Vernon-Rough Broken Land association covers about 10 percent of the county. The Vernon soils are the smoother areas. Rough Broken Land consists of steep escarpments, canyons, and gullied areas. Included in these areas are beds of gypsum mixed with the clays of the redbeds. Harmon soils are shallow soils of this association. This association is not suitable for cultivation, but with proper

management this land is often used for pasture.

6. The Spur-Port Association covers about 6 percent of the county. This association lies along the major creeks. The Port soils are dark and occupy higher positions than the Spur soils. About three-fourths of this association is in cultivation and is used mainly for cotton, alfalfa, small grain, and sorghum.

7. The Alluvial Land-Yahola association is on the flood plains of the rivers and covers about 6 percent of the county. The alluvial land is made up of sandy soils on the lower part of the flood plain. The Yahola soils are farther from the river channel and are less sandy. This association is used mainly for range. Some crops are grown on them.

8. The Granitic Mountains association consists of stony granitic hills in the eastern part of the county and were not considered in this survey.

Frie, Brinlee, and Graft (1967) describe nine soil associations for Greer county. A brief description for each association is given below (Figure 4).

1. The Miles-Springer-Tivoli association comprises 24 percent of the county. This soil association is on nearly level to strongly sloping uplands with a few dunes. The Miles soils make up most of the association and are nearly level to sloping. The Springer soils are gently to strongly sloping and the Tivoli soils are on stabilized dunes. Much of the acreage of this association is cultivated. Cotton is the main crop, but wheat, rye and grain sorghum are also grown. The land has to be well managed due to the high erosion rate and the rapid loss of fertility.

2. The St. Paul-Woodward-Quinlan association occurs in the north-central and northwestern parts of the county and is therefore outside the scope of this study area.

3. The Hollister-Tillman association makes up 10 percent of the county. The soils are of broad uplands that are formed in old alluvium or in material from clay and shale. The Hollister and Abilene soils are formed in calcareous old alluvium and the Tillman soils are nearly level and are formed in calcareous material. Nearly all of this association is cultivated. Wheat is the main crop, but other crops are also grown. These soils are also often irrigated.

4. The Lawton association makes up about 8 percent of the county. This association occupies nearly level or gently sloping uplands, broken by steep, stony hills. Much of

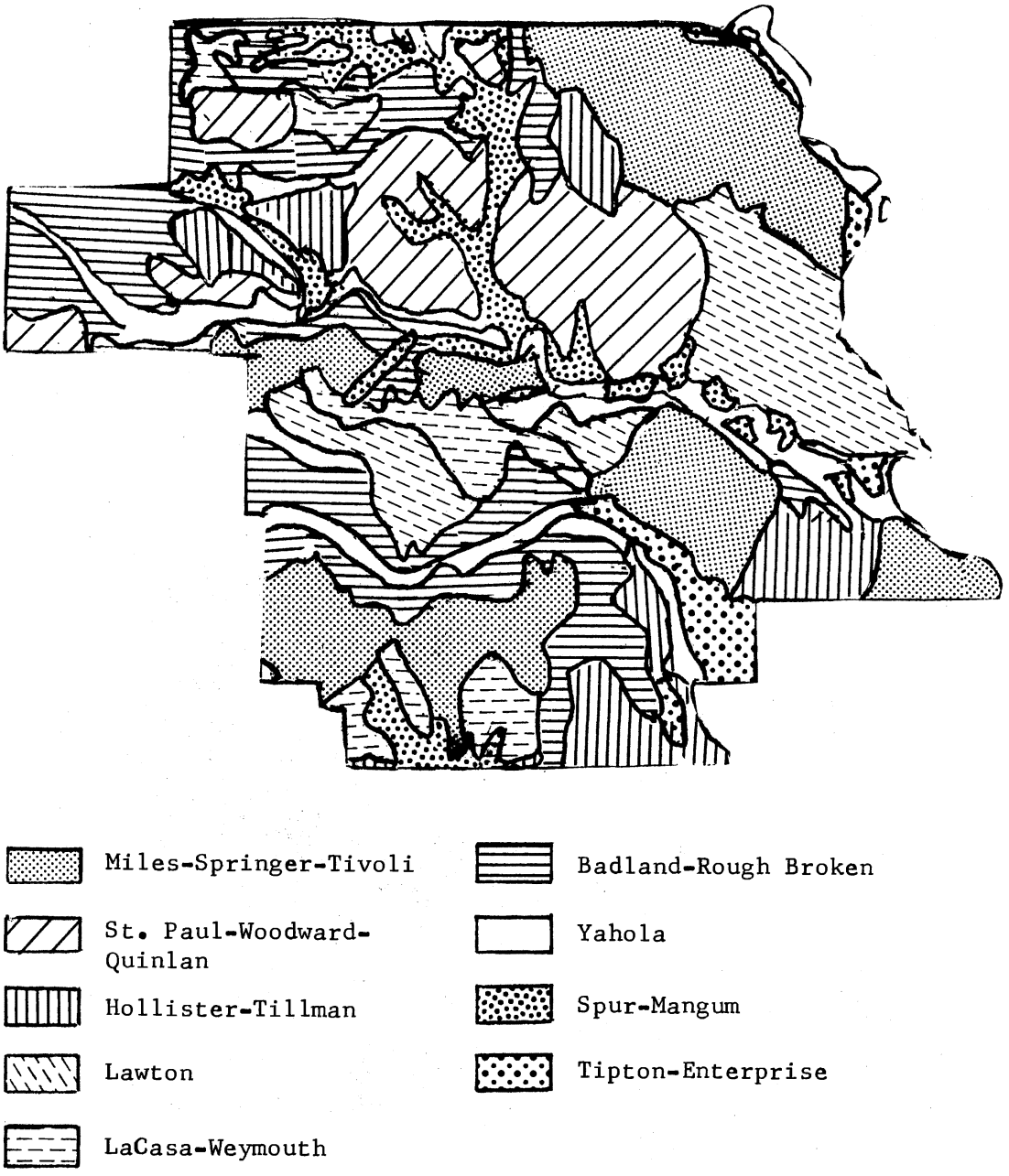


Figure 4. Soil Associations for Greer County (Frie, Brinlee, and Graft, 1967).

this association is cultivated. Wheat and cotton are the main crops. Fields sown to winter wheat provide excellent pasture for beef cattle. The soils are also suitable for irrigation.

5. The LaCasa-Weymouth association consists of gently sloping and sloping soils of the uplands. The LaCasa and Weymouth soils formed in material from calcareous clay or shale. The Tarrant soils often intermingle with the Weymouth soils. Much of the land of this association is cultivated, mainly to wheat. The rest of the land is used for rangeland, but the ranges are difficult to manage.

6. The Badland-Rough Broken Land association makes up about 21 percent of the county. This association is rugged and is characterized by steep escarpments. Rocks of the Permian redbeds are exposed in a few areas. Much of this association is in native range and is used for grazing. Management is very difficult and forage production ranges from very poor to good. Where the soils contain gypsum care must be taken when selecting ponds.

7. The Sandy alluvial land-Yahola association covers 5 percent of the county. This association is made up of calcareous, nearly level soils on the flood plains of the rivers. The Yahola soils are in general found on higher areas. About 65 percent of the Yahola soils are cultivated, mainly to cotton, wheat, and alfalfa. Good range management is needed in this area.

8. The Spur-Mangum association makes up about 6 percent of the county. These are soils of the flood plains that formed in loamy and clayey alluvium. The Spur soils are mainly nearly level. The Mangum soils are dominant in nearly level areas that are occasionally overflowed. Nearly all of the Spur soils are cultivated. Wheat, cotton, and alfalfa are the main crops. The Mangum soils are mainly used for range rather than cultivation.

9. The Tipton-Enterprise association covers about 3 percent of the county. These are nearly level to strongly sloping soils. These soils make up the terraces along the Red River. Wheat, cotton, and alfalfa are grown on nearly all the land. The soils of this association are fertile to highly fertile. A large acreage of the area is irrigated.

No complete soil survey report for Harmon county has been published, but the Soil Conservation Service (1973) has mapped the major soil associations for the county (Figure 5). A brief description for each of the eight associations is given below.

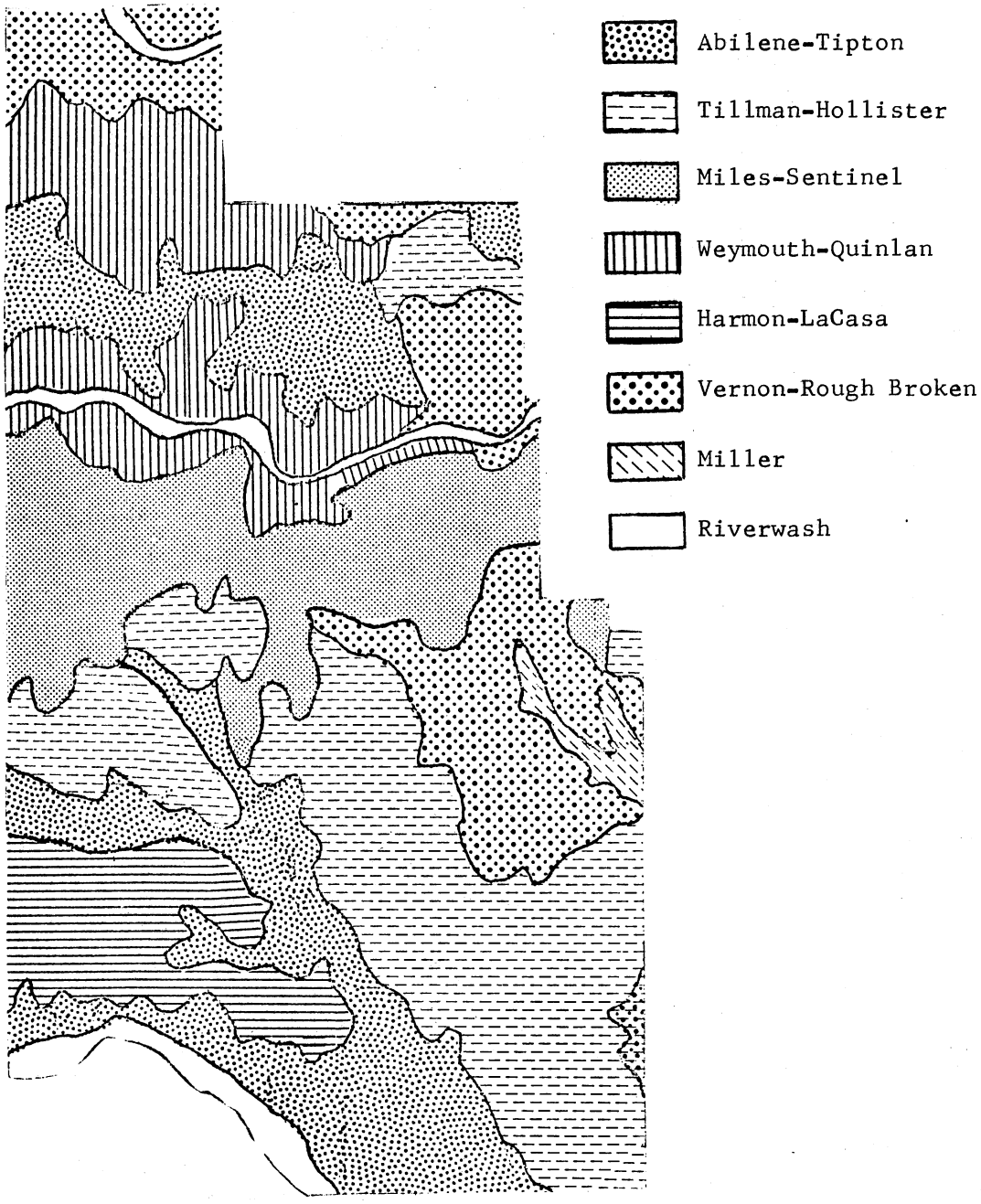


Figure 5. Soil Associations for Harmon County (SCS, 1973).

1. The Abilene-Tipton association is composed of deep upland soils with silty surfaces and permeable subsoils on nearly level to gently sloping topography. The main crops are cotton, wheat, milo, and alfalfa. The rangeland on this association is mostly on droughty soils. Mesquite is a problem on the rangeland of this association.

2. The Tillman-Hollister association consists of deep upland soils with silty surfaces. They are nearly level to very gently sloping. Cotton is the main irrigated crop.

3. The Miles-Sentinel association is composed of deep upland soils with sandy surfaces. The principal crops are sorghum and cotton. The major soil problem of the area is wind erosion.

4. The Weymouth-Quinlan association consists of shallow to deep soils, loamy throughout. The soils are gently sloping to steeply sloping. Most of this association is used for rangeland.

5. The Harmon-LaCasa association consists of shallow to shallow upland soils with loamy surfaces. The land is mainly used for rangeland, but mesquite is a problem on the ranges.

6. The Vernon-Rough Broken Land association is made up of very shallow to shallow upland soils with clayey surfaces. The slopes are gentle to steep. The soils are used primarily for rangeland. The shallow clayed soils cause drouthiness, therefore, maintaining an adequate vegetation cover is a problem.

7. The Miller association is composed of deep, clayey, bottomland soils used principally as cropland. Wheat has been almost exclusively the only crop grown on this soil.

8. The Riverwash association consists of deep sandy, bottomland soils used principally as rangeland. These soils produce a fair amount of forage, but the fertility is very low.

CHAPTER IV

CLIMATE

The climate of the three county area is continental, warm-temperate, and subhumid. The major climatic variations are caused by the alternating movement of warm, moist air from the Gulf of Mexico and cool, dry air from the north. Daily and seasonal variations in the climate are often sudden and extreme. The months of greatest rainfall are April, May, and June and then the fall months of September and October. Most of the rains are of short duration and high intensity. The soils are driest in July and August when high temperatures and hot, dry winds remove moisture rapidly. Moisture is often removed from leaves faster than it can be supplied and the plants are unable to recover.

The average rainfall for Jackson county is 25 inches. The lowest amount ever recored was 13.92 inches in 1917 and the wettest year was 1941 with 49.30 inches. The average snowfall is 6.7 inches with snow rarely covering the ground for more than 2 weeks, generally only 2-4 days. The average growing season is 224 days. The average last frost in the spring is March 28 and the average first fall frost is November 7th (Bailey and Graft, 1961).

The average rainfall for Greer County is 23.68 inches. Annual amounts have ranged from a low of 10.86 inches in 1910 to as much as 45.13 inches in 1923. The average snowfall ranges from 6.5 inches

in the southeastern part of the county to 8.5 inches in the northwestern part of the county. The growing season ranges from 209 days in the northwest to 225 days in the southeast. The average last spring freeze is November 4th (Frie, Brinlee, and Graft, 1967).

The average rainfall for Harmon county is 23.2 inches. The amounts have ranged from a low of 9.79 inches in 1933 and a high of 45.15 inches in 1941. The average growing season is 225 days. The average last killing frost is March 30th and the average first killing frost is November 10th (U. S. D. A. Soil Conservation Service, 1973).

Temperature and rainfall records were recorded at the Altus Irrigation Research Station, which is located in the south-central portion of the collection area in Jackson county. Evaporation data was taken from Altus dam at Lake Altus in Greer county. Temperature is recorded in degrees Fahrenheit; precipitation and evaporation are recorded in inches.

Climatically, this year was an unusual year for the study area, as indicated in Tables V-VII. Temperatures were generally below average for the year. Precipitation on the average was higher in the summer months, but evaporation for the early part of the summer was greater than usual. In July 6.94 inches of the 7.13 inches of rain came in a three day period, the 24th through the 26th. Therefore, most of July was dry and the soil was baked. With the end of July and the first part of August came more rain. September and October, usually wet months, were exceptionally dry.

The prolonged winter retarded spring plants flowering, however, high amounts of rainfall in May and June allowed many of these plants

TABLE V

AVERAGE TEMPERATURES AND DEPARTURE FROM AVERAGE
FOR THE MONTHS JANUARY THROUGH OCTOBER 1975 *

Month	Average	Departure
January	42.2	2.2
February	39.4	-5.2
March	50.1	-1.3
April	60.7	-2.6
May	70.2	-1.3
June	78.7	-1.6
July	80.0	-4.3
August	81.0	-2.6
September	70.5	-5.1
October	65.4	.6

* From Oklahoma Climatological Data, Monthly Summaries, 1975.

TABLE VI

PRECIPITATION AND DEPARTURE FROM AVERAGE FOR THE MONTHS JANUARY THROUGH OCTOBER 1975 *

Month	Average	Departure
January	1.58	.74
February	2.06	1.04
March	.90	- .36
April	.89	-1.20
May	4.61	.31
June	5.18	1.70
July	7.13	5.06
August	1.96	- .10
September	2.22	- .23
October	.74	-2.05

* From Oklahoma Climatological Data, Monthly Summaries, 1975.

TABLE VII

EVAPORATION AND DEPARTURE FROM AVERAGE FOR THE MONTHS JANUARY THROUGH OCTOBER 1975 *

Month	Evaporation[1]	Departure
January	-	-
February	-	-
March	5.05	1.13
April	7.03	1.37
May	9.58	1.49
June	11.63	1.38
July	-	-
August	10.13	-2.18
September	-	-
October	-	-

[1] Evaporation is measured in inches from a standard weather service-type pan with a four foot diameter.

* From Oklahoma Climatological Data, Monthly Summaries, 1975 for the Altus Dam Station.

to persist into the summer. The largest number of plants were collected in these two months when the climate was most favorable for plant growth. The relatively low amount of rainfall in July, excluding the wet three day period at the end of the month, and the high evaporation rate created poor growing conditions for the plants, with many plants being smaller than normal. With the rains in late July and early August, conditions once again improved for the plants. The number of plants flowering again decreased with the dryness of September and October.

CHAPTER V

ECONOMY

The economy of Harmon, Jackson, and Greer counties is almost entirely dependent upon agriculture. Cattle, cotton and wheat are the main revenue sources for the three counties. The total land area of the three counties is 1,272,256 acres with 1,202,800 acres or 94.5 % of the land in farms (Census of Agriculture, 1969). These farms support the majority of the 44,017 people living in the three county area (Census of Population, 1970). Jackson county, population 30,902 is the only county of the three counties with an urban population. The largest city is Altus, population 23,302. The The primary employer for the city is Altus Air Force Base located on the northeastern edge of the city. Other towns of the county are rural farm communities. In order of size they are Blair, population 1,114; Olustee, population 897; Eldorado, population 737; Duke, population 486; and Martha, population 268. Republic Gypsum, a relatively new gypsum plant is housed at Duke. Eagle-Picher industries owns a copper mine near Creta in the county.

Greer county has a population of 7,979. Mangum is the only town of any significant size with a population of 4,066. The other rural communities in order of size are Granite, population 1,808; Willow, population 188; and Brinkman, population 7.

The least populated of the three counties is Harmon county,

population 5,136. Hollis, the county seat, is the largest town with a population of 3,150. The other communities are quite small with Gould being the second largest town with 368 people (Figure 6).

The agricultural use of the land of the three counties is divided equally between crop production and cattle production. The total agricultural market value for the three counties was $34,698,769 in 1969 with $19,665,325 being from livestock and their products and $15,033,445 from crops. The total acreage is 503,164 in pastureland including cropland and woodland used for pasture. There are 9,189 acres of woodland in the three counties with 6,421 acres being used for pastureland. Table VIII summarizes the acreage used for crop production. The total crop acreage includes 25,382 with cover crops being used only to improve the land.

The extensive use of the land for agricultural purposes has had a pronounced effect upon the vegetation. Indicators of overgrazing such as Gutierrezia dracunculoides (DC.) Blake are often quite abundant in the fields. Extensive cultivation of the land for crop plants has destroyed many of the habitats for the native plants.

Two industries of the area which have had an effect upon the vegetation is that of gypsum and copper mining. Between Elmer and Eldorado there is an extensive area of copper mining near Greta. Republic Gypsum, located in Duke, has a mine near the plant (Johnson, 1964). The mining has also destroyed many of the habitats for the plants, but along the edges of the mining area, the native plants can still be found.

The three county area has not been very profitable for the

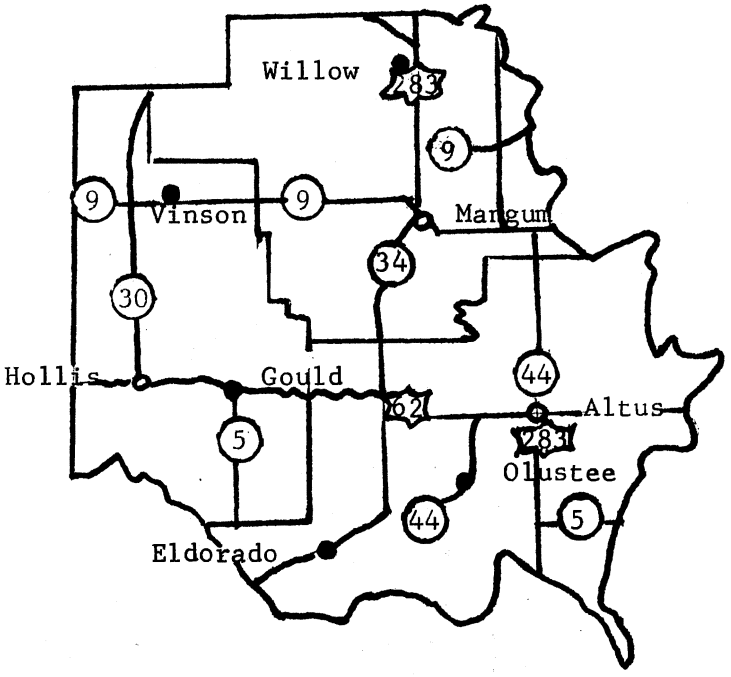


Figure 6. Towns and Major Highways (Modified from Official State Highway Map, 1973).

TABLE VIII

SUMMARY OF ACREAGE USED FOR CROP PRODUCTION

Industry	Jackson	Harmon	Greer	Total
Wheat and other small grains	128,595	47,617	68,714	244,926
Cotton	40,722	30,634	24,239	95,595
Hay	13,147	11,799	6,289	31,235
Sorghum	13,111	10,709	6,109	29,929
Peanuts, Soybeans, and Corn	1,537	268	526	2,331
Total Crops	197,112	101,027	105,877	404,016

oil and gas industry. Clifton (1928) did an extensive geological survey of the area with respect to oil and gas and predicted that the area probably would not produce much gas and oil. In 1963 there were thirty-one oil and gas industries in the three county area (Census of Mineral Industries, 1963). In 1967 the number had been reduced to fourteen (Census of Mineral Industries, 1967). The industry has undoubtedly had a small impact upon the vegetation of the area, but the effect is not as pronounced as the effect of the agricultural industry.

CHAPTER VI

HISTORY

The first European to set foot in what is now western Oklahoma was Vasquez de Coronado in 1541. There were no botanists in the group, but in a report to the "Holy Catholic Caesarian Majesty" he noted (Featherly, p. 10), "We found no kind of wood in all these plains away from the gullies and rivers, which were very few". His description is an accurate one for the western part of Oklahoma (Featherly, 1943).

In the year 1601 Juan de Onate of Santa Fe crossed a part of what is now Oklahoma. He stated that the ground was useless for agriculture and suitable only for a hunting ground for savage tribes (Featherly, 1943).

In 1820 Stephen Harriman Long was commissioned to command the "Yellowstone Expedition" from St. Louis to Wyoming (McKelvey, 1955). Dr. Edwin James was appointed to serve as botanist and geologist for the expedition. Traveling on horseback the group departed April 24, 1820. As they entered the Great Plains of Iowa and Missouri, James commented (McKelvey, p. 212):

> These vast plains in which the eye finds no object to rest upon, are at first seen with surprise and pleasure, but their uniformity at length becomes tiresome.... Nothing is more difficult than to estimate, by the eye, the distance of objects seen in these plains.... A small animal, as a wolf or turkey appears the magnitude of a horse.

As they crossed Nebraska, James noted changes of the vegetation. Prickly poppy (Argemone alba) and Adam's needles (Yucca angustifolia) were noted. As the expedition traveled farther west desert plants, cacti, and sagebrush became more abundant. On June 26th the group entered Colorado. The group explored the Rocky Mountains approximately one month. On July 24th Long, James, and another member of the party went southward from Colorado to search for sources of the Red River. On August 17th the three men crossed from Hemphill county, Texas into the Antelope Hills area of Roger Mills county, Oklahoma. They were to travel in Oklahoma until September 13th. James, compiler of records for the expedition, was impressed by the elevated plain and stated (McKelvey, p. 232):

> The luxuriance and fineness of grasses, as well as the astonishing number and good condition of the herbivorous animals of this region clearly indicate its value for purposes of pasturage.

The three men went eastward from there into the Ozarks and on September 19th crossed into Arkansas.

James W. Abert was commissioned by congress in 1845 to survey the Canadian River in western Oklahoma (Abert, 1846). The expedition left on August 9th from Bent's Fort on the Arkansas River. Very little was recorded concerning the vegetation, but the following is his brief description of the area (Abert, p. 14):

> We noticed a profusion of prairie sage, Artemisia tridentata, being about the only shrub that grows in these sandy regions. This plant seems to love a dry and arid soil....In some places it grew so luxuriantly that the stalks might be used for fuel. We were disappointed in not seeing even one specimen of the sage cock, Tetrao upophrasianus, which is so extravagantly fond of feeding on this plant that its flesh becomes so embittered as to render it perfectly uneatable. Not withstanding the abundance of the plant, we did not see a single specimen

> of this bird during the trip. Cacti were numerous, and a species of Cucurbitaceae, Cucurbita aurantia, bearing a small spherical gourd, orange-colored. These plants are characteristic of the dry sandy plains.

On September 20th the group encountered the gypsum and Abert commented (Abert, p. 93):

> We continued to follow the river, and became involved in difficult ground, which was high and rough, composed of red clay filled with gypsum, which is found so generally to pervade this country. The waters percolating the immense masses of this mineral, separate the sulphuric acid from the lime, and acquire an extremely nauseous taste, anything but agreeable to wayworn travellers, although our animals appear to relish it much.

They were forced to follow a serpentine course of travel on account of deep ravines of red clay and gypsum buttes. On September 23rd the group was 20 miles west of the Antelope buttes.

In 1852 Captain R. B. Marcy led an expedition to explore the Red River boundary between Texas and Oklahoma (Marcy, 1854). The expedition went from Fort Arbuckle through the Wichita Mountains to the source of the North Fork of the Red River. Dr. G. G. Shumard, surgeon of the expedition, collected about 200 species of plants. Determinations of the plants were done by Dr. John Torrey, who reported that many of the plants were rare and that the flora resembled that of the upper portion of the Canadian River. Most of the plants on the list were from the Wichita Mountains. As the party rode through the Wichitas toward the Red River, Marcy noted (Marcy, p. 12):

> As we advance, the country away from the borders of the water-courses becomes more barren and woodlands are less frequently met with; indeed, upon the river there is no other timber but cottonwood (Populus angulata) and elm (Ulmus americana), and these in very small quantities; for the most part the valley of the river along where we passed today is entirely destitute of trees.

He described the sand-hills to be ten to thirty feet high and the vegetation sparse with weeds, grapevines, and plumbushes. They met Chief GanajeHexie of the Wichita tribe, as they were leaving the mountains. He told them (Marcy, p. 17-18), "When you should leave the mountains to go down to the river, the country will be flat prairie country, totally destitute of water, wood, or grass and the only substitute for fuel would be buffalo 'chips' ".

As the party moved out of the mountains onto the prairie, Marcy described the area as having the appearance of a meadow that has been recently mowed close to earth due to the buffalo grass. He described the river banks as having mesquite trees and grama grasses and the sandstone hills with weeds and dwarf oaks. The group had hopes that the descriptions of the area that the Indians had given were erroneous. They soon discovered, however, that they were not. The water in the Salt Fork was bitter and unpalatable and caused nausea. The group encountered gypsum forming an immense belt. He described it as being much elevated above the surrounding country, very smooth, and level, spreading out in every direction without trees or shrubs --- "a barren solitude".

Captain Whipple headed a survey party to explore a route for a railroad from the Mississippi River to the Pacific Coast in 1853. Dr. J. M. Bigelow was the botanist of the expedition, and collected 125 species. Drs. John Torrey and Asa Gray wrote the botanical descriptions for the plants collected on the expedition (Bigelow, 1855).

As the group entered the western part of Oklahoma they noted gypsum in every variety of form and that there was a lack of trees

and scarcity of grass.

They crossed Elm and Gypsum creeks and passed through a new sandstone that a geologist named "new red". Gypsum beds outcrop in these sandstones. The party camped in the Antelope Hills area of scanty grass relieved only by red gullies and occasional ravines.

Bigelow (1855) noted the first appearance of grama-grass on the north side of the Canadian River at longitude 96° west. He noted the fact that grama-grasses and buffalo grass are important because they retain nutritive quality all year round and that they are only well adapted to arid climates in their native states. Apart from the grasses, the most notable plants were evening primrose, Ambrosia, and golden rods on the plains and prairie plums on the streams. The entire area was described by Bigelow as having a considerable number of Cactaceae, especially Opuntia macrorhiza. From Oklahoma the party went to the Pecos and Rio Grande river valleys.

From 1875-1877 Dr. T. E. Wilcox collected plants in what is now western Oklahoma and the determinations were done by Alphonso Wood. No further details of the excursion were given (Henson, 1941).

More recent studies of the area are very few. In 1932 a student at the University of Oklahoma, Rotha Zelma Bull, compiled a list of plants of Greer county as part of her master's program. The study area included the extension of the Wichita system into the southwestern corner of the state.

Waterfall (1950) published a short paper listing new additions to the state flora after a summer of collecting in Harmon and

Jackson counties. These are the only two extensive botanical studies made in the area in recent years.

CHAPTER VII

ECOLOGICAL CONSIDERATIONS

Blair and Hubbell (1938) list two biotic districts within the boundaries of the study area, the Mesquite Plains and Mixed-grass Plains districts. The Mesquite Plains district is included to a greater extent in the gypsum hills region and only to a lesser degree in the redbed plains district. This province takes in approximately one-half of the land area included in the study. It includes vegetation mostly of the Mangum Gypsum Hills geomorphic province and soils of the Tillman-Hollister, LaCasa-Weymouth, and Vernon Rough Broken land associations. The principal vegetation is a mesquite grassland type with mesquite (Prosopis glandulosa) being the dominant woody vegetation and buffalo grass (Buchloe dactyloides) as the dominant herbaceous species. Desert cactus (Opuntia leptocaulis) is also abundant. Scirpus marshes are quite often observed around the mouths of the creeks in this district. The Mixed-grass Plains district comprises all of western Oklahoma except the Panhandle and the Wichita Mountains district. The district includes vegetation both of the Central Redbed Plains and the Mangum Gypsum Hills geomorphic provinces. The soils are basically of the Tillman-Hollister and Miles-Sentinel soil associations. The principal plants of the district are the grama grasses, blue grama (Bouteloua gracilis), hairy grama (B. hirsuta)

and side-oats grama (B. curtipendula), buffalo grass, and little bluestem (Andropogon scoparius). On the deeper soils western wheat-grass (Agropyron smithii) and silver bluestem (Andropogon saccharoides) are abundant.

Within each biotic district distinctive plant associations and communities can be seen. Six plant associations are included in the study area, mixed grass eroded plains, mesquite grassland, sandsage grassland, shinnery oak grassland, woodland of creek and river floodplains and aquatic communities (Figure 7).

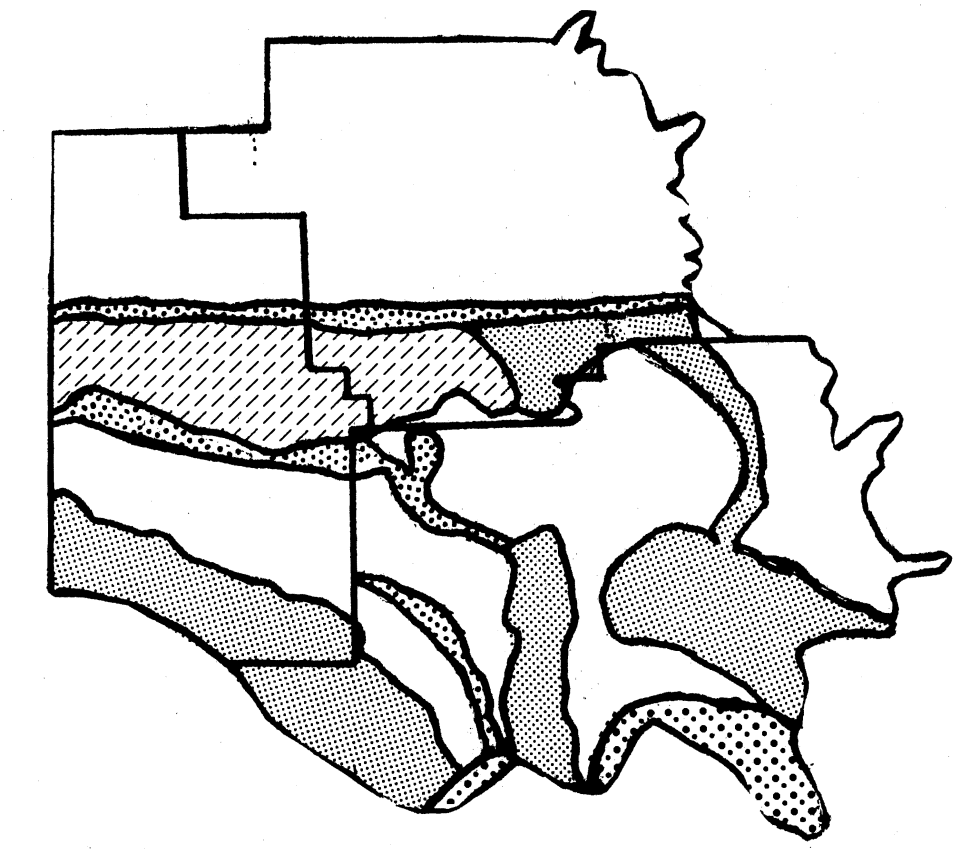
The most extensive plant association is that of the mixed-grass prairie type which includes two distinct grassland communities. The first community is that of shallow soils mostly of the Vernon Rough Broken land association and generally includes the grassland of the gypsum hills (Figures 8 & 9). In early spring very few grasses are in flower, but various forbs dominate the landscape which include the following:

> false nightshade (Chaemaesaracha conioides), (Cymopterus macrorhizus), puccoon (Lithospermum incisum), Indian paint-brush (Castilleja citrina) rose vervain (Verbena canadensis), Texas yellow star (Lindheimera texana), flax (Linum rigidum), and prairie flax (Linum lewisii).

In late spring, late April through May still another set of forbs dominates the scene:

> loco weeds (Astragalus racemosus and other Astragalus species), evening primrose (Calylophus hartweggii, var. pubescens), paper flower (Psilostrophe villosa), aster (Aster leucelene), skull cap (Scutellaria drummondii), bladder-pod (Lesquerella gordonii), (Nama stevensii), lazy daisy (Aphanostephus ramo-sisimus), beard tongue (Penstemon fendleri), scarlet globe mallow (Sphaeralcea coccinea), (Happlopappus spinulosis), lemon beebalm (Monarda citridora), and (Phacelia integri-folia).

By June the grasses have started flowering and the forbs are still



Mixed-Grass Eroded Plain

Sandsage Grassland

Shinnery-Oak Grassland

Mesquite Grassland

Woodland of Creeks and River Floodplains

Figure 7. Plant Associations.

Figure 8. Mixed-grass Prairie of Rough Broken Land

Figure 9. Mixed-grass Prairie of Rough Broken Land

abundant. The forbs include:

> (Dalea enneandra), mock pennyroyal (Hedeoma drummondii), prairie clover (Petalostemum candidum, var. oligophyllum), basket flower (Centaurea americana), stick leaf (Mentzelia nuda and other Mentzelia species), (Haploesthes greggii), and evening primrose (Calylophus serrulatus).

The grasses include:

> tumblegrass (Schedonnardus paniculatus), white tridens (Tridens albescens), tobosa (Hilaria mutica), (Erioneuron pilosum), and Canada wild rye (Elymus canadensis).

From July until October the dominant grasses are flowering and dominate the landscape:

> blue grama, hairy grama, side-oats grama, sand dropseed (Sporobolus cryptandrus), (Tridens elongatus), little bluestem, and tall dropseed (Sporobolus asper).

Numerous forbs are also abundant until frost. These include:

> scurfy pea (Psoralea tenuiflora), Missouri goldenrod (Solidago missourensis), amd bluet (Hedyotis nigricans).

The second grassland community of mixed grass eroded plains consists mostly of Tillman-Hollister and Miles-Sentinel soil associations which are deep upland soils. In early spring forbs and winter annuals dominate the scene (Figures 10 & 11). They include:

> common speedwell (Veronica arvensis), purslane speedwell (Veronica peregrina), creeping lady's sorrel (Oxalis corniculata), tansy mustards (Descurainia pinnata and D. sophia), shepherd's purse (Capsella bursa-pastoris), mousetail (Myosurus minimus), plaintain (Plantago purshii), loco weed, bladder pod, prairie flax, windflower (Anemone caroliniana), Indian paintbrush, false dandelion (Pyrrhopappus multicaulis var. geiseri), Engelmann daisy (Engelmannia pinnatifida), spiderwort (Tradescantia ohiensis), wine cup (Callirhoe involucrata), rabbit-tobacco (Evax verna), oats (Avena sativa), Japanese brome (Bromus japonicus), thistle (Cirsium texanum), canary grass (Phalaris caroliniana), (Psoralea cuspidata), zinnia (Zinnia grandiflora), skull-cap (Scutellaria wrightii), and prickly pear (Opuntia compressa).

By the summer another set of forbs is in full flower. They include:

> widow's tears (Commelina erecta), prickly poppy (Argemone

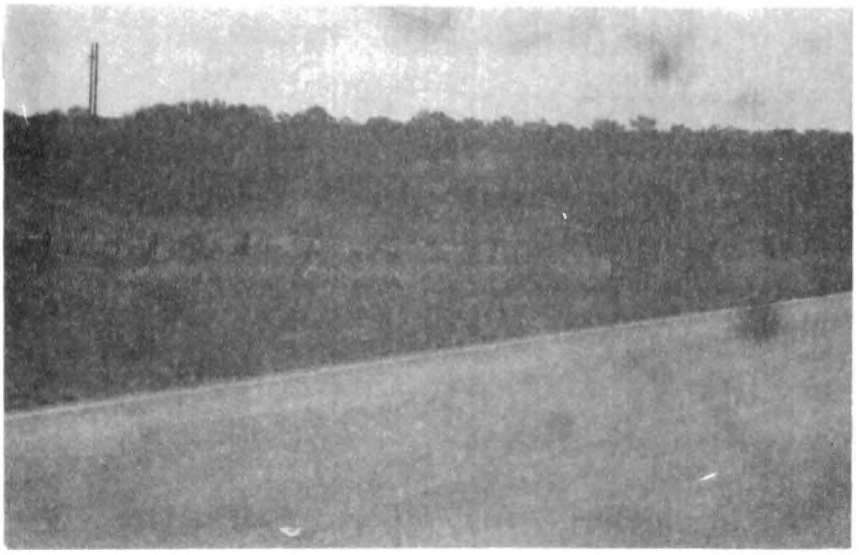


Figure 10. Mixed-grass and Mesquite Grassland of Tillman-Hollister.

Figure 11. Mixed-grass and Mesquite Grassland of Tillman-Hollister.

polyanthemos), sensitive briar (Schrankia uncinata), fern acacea (Acacia hirta), (Nama hispidum), and golden aster (Chrysopsis villosa, var. canescens).

A few grasses ahve started to flower by June. These include:

rabbitfoot grass (Polypogon monspeliensis), side-oats grama, western wheatgrass, and prairie three-awn (Aristida purpurea and other Aristida species).

From August through October, the dominant grasses are in full flower. These include:

blue grama, hairy grama, bristle grass (Setaria viridis), silver bluestem, tall dropseed, big bluestem (Andropogon gerardii), little bluestem, purple top (Tridens flavus), and annual three-awn (Aristida oligantha).

Forbs that are present in the fall include:

(Palafoxia sphacelata), whitlow-wort (Paronychia jamesii), ironweed (Vernonia baldwinii), dotted gay-feather (Liatris punctata), matchweed (Gutierrezia sarothrae), annual buckwheat (Eriogonum annuum), and blue sage (Salvia azurea).

The mesquite grassland association can also be divided into two grassland types. The two communities vary little from the grassland communities of the mixed eroded plain association. In aspect they are the same with the exception of mesquite, and abrojo (Opuntia davisii), which are dominant life forms on the deeper soils and Mormon's tea (Ephedra antisiphilitica), and buckthorn (Condalia obtusifolia) are dominant life forms on the typically Rough Broken land or gypsum soils.

One of the most distinctive associations of the mixed grass eroded plains district is that of the Sandsage grassland which predominate on sand dunes on the north side of most streams (Figure 12). Sandsage (Artemisia filifolia), sand plum (Prunus angustifolia), lemon sumac (Rhus aromatica), and sand bluestem (Andropogon hallii) are the most distinctive indicators of the stabilized dune

Figure 12. Sandsage Grassland Association.

Figure 13. Woodland and Scirpus Marsh Area of River Flood Plain.

areas. The vegetation of the sand area appears much more distinct than that of the other associations. In the spring mostly forbs are blooming, with a few grasses intermingled. The list includes:

> false nightshade, bluet (Hedyotis humifusa), (Cryptantha minima), bladder-pod, vetch (Vicia ludoviciana), Texas bluegrass (Poa arachnifera), rescue grass (Bromus unioloides), pepper grass (Lepidium virginicum), evening primrose (Calylophus serrulatus), bullnettle (Cnidoscolus texanus), venus-looking glass (Triodanis holzingeri), three-awn (Aristida longiseta), Indian blanket (Gaillardia pulchella), catch-fly (Silene antirrhina), skeleton-plant (Lygodesmia aphylla), Queen's Delight (Stillingia sylvatica), plaintains (Plantago spp.), and cut leaved evening primrose (Oenothera laciniata).

By the beginning of the summer the area is still dominated by forbs, but the grasses are beginning to flower also. The forbs include:

> widow's tears, thistle, scarlet pea (Indigofera miniata), milkweed (Asclepias arenaria), (Petalostemum villosum), cowpen daisy (Verbesina encelioides), and (Oenthera rhombipetala).

The grasses include:

> rabbitfoot grass, hooded fingergrass (Chloris cucullata), sand dropseed, and silver bluestem.

With the coming of the fall, still mostly forbs are dominant. Unlike the other associations where grasses are the main plants in the fall, forbs still dominate in this vegetation type. The grasses include:

> bristlegrass (Setaria leucophila), sand bluestem, sand lovegrass (Eragrostis trichodes), giant sandreed (Calamovilfa gigantea), and red lovegrass (Eragrostis oxylepis).

The fall forbs are mostly members of the Compositae. The list includes:

> Scratch-daisy (Haplopappus divaricatus), aster (Aster subulatus, western ragweed (Ambrosia psilostachya), golden aster (Heterotheca latifolia), and sand groundsel (Senecio riddellii).

The shinnery oak association is also a sand association and has essentially the same dominant species as the sandsage grassland area except that shinnery oak (Quercus harvardii) is the dominant species. Other dominants such as sand plum and sand lovegrass, etc. are present.

Another plant association of the study area is that of the woodland of the creeks and river flood plains (Figure 13). The woody vegetation includes:

> cottonwood (Populus deltoides), black willow (Salix nigra), American elm (Ulmus americana), hackberry (Geltis spp.), soapberry (Sapindus drummondii), and salt cedar (Tamarix gallica).

The understory includes:

> rush (Scirpus americanus), switchgrass (Panicum virgatum), Johnson grass (Sorghum halapense), barnyard grass (Echinochloa crusgalli), nut grass (Cyperus uniflorus), saltgrass (Distichlis spicata var. stricta), canela (Pluchea purpurascens), water pimpernel (Samolus ebracteatus), smartweed (Polygonum lapthifolium), and cockle bur (Xanthium strumarium).

The final community is comprised of the plants from the stock ponds, the aquatic community. These ponds are temporary and tend to have a high evaporation rate during the summer months, therefore, the aquatics of these communities are temporal. The plants include:

> cattail (Typha angustifolia), smartweed (Polygonum bicorne), water clover (Marsilea mucronata), tooth-cup (Ammania coccinea), sneezeweed (Helenium microcephalum), and spikerushes (Eleocharis macrostachya and E. compressa).

One other area needs to be discussed. Shelter belts are common in the southwestern part of the state. These were probably established in the 1930's during the "dust bowl" days. This accounts for some unusual range extensions occuring in the area including green ash (Fraxinus pennsylvanica), honey locust (Gleditsia triacanthos), and desert willow (Chilopsis linearis).

CHAPTER VIII

A COMPARISON OF THE GYPSUM AND REDBED TAXA

An important aspect of the study was the comparison of the gypsum and redbed floras. 187 species were found to occur on the redbed plains soils, excluding the sand areas; whereas 108 species were found on gypsum. Although gypsum soils are very fertile, they are often shallow and very dry, conditions that are not conducive to plant growth. Application of gypsum to soils causes an increase in exchangeable calcium and a decrease in exchangeable sodium, thus improving physical conditions for soil and plant growth. Magnesium, potassium and nitrogen levels all increase within a plant in the presence of gypsum (Poonia and Bhumbla, 1973). However, soils of 100 % gypsum exhibited a marked decrease of the same nutrients.

The aspects of the two areas are certainly distinct as can be seen from the previous discussion of the two grassland communities, which coincide quite well with the gypsum and redbed soil types. A comparison of the floras is given below. The list excludes sand species.

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
MARSILEACEAE			
Marsilea mucronata		x	
POLYPODIACEAE			

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
Pellaea atropurpurea	x		
CUPRESSACEAE			
Juniperus pinchoti	x		
J. virginiana		x	
GNETACEAE			
Ephedra antisiphilitica	x		
GRAMINEAE			
Agropyron smithii		x	
Andropogon gerardii		x	
A. ischaemum		x	
A. saccharoides		x	
A. scoparius			x
Aristida fendleriana		x	
A. longiseta	x		
A. oligantha		x	
A. purpurea		x	
A. wrightii		x	
Arundo donax		x	
Avena sativa		x	
Bouteloua curtipendula			x
B. gracilis			x
B. hirsuta			x
Buchloe dactyloides			x
Elymus canadensis			x
E. virginicus		x	
Erioneuron pilosum			x
Hilaria mutica	x		
Phalaris caroliniana		x	
Poa arachnifera		x	
Polypogon monseliensis		x	
Schedonnardus paniculatus	x		

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
Sorghastrum nutans		x	
Sporobolus airoides	x		
S. asper			x
S. cryptandrus	x		
Tridens albescens			x
T. elongatus	x		
T. flavus		x	
COMMELINACEAE			
Tradescantia ohiensis		x	
LILIACEAE			
Yucca glauca			x
IRIDACEAE			
Sisyrinchium angustifolium		x	
POLYGONACEAE			
Eriogonum annuum		x	
E. longifolium		x	
CHENOPODIACEAE			
Atriplex canescens	x		
AMARANTHACEAE			
Tidestromia lanuginosa		x	
NYCTAGINACEAE			
Mirabilis linearis			x
ILLECEBRACEAE			
Paronychia jamesii			x
RANUNCULACEAE			
Anemone caroliniana		x	
Delphinium virescens		x	
Myosurus minimus		x	
CRUCIFERAE			
Erysimum repandum		x	
Lepidium austrinum		x	
L. virginicum		x	

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
Lesquerella gordonii			x
LEGUMINOSAE			
Acacia hirta		x	
Astragalus lindheimeri			x
A. lotiflorus	x		
A. missouriensis	x		
A. mollissimus	x		
A. nuttallianus		x	
A. plattensis	x		
A. racemosus	x		
Cassia fasciculata		x	
Dalea aurea		x	
D. enneandra			x
Hoffmanseggia densiflora			x
Mimosa borealis			x
Petalostemum candidum			x
Prosopis glandulosa			x
Psoralea cuspidata			x
P. tenuiflora			x
Schrankia uncinata			x
LINACEAE			
Linum lewisii			x
L. rigidum			x
OXALIDACEAE			
Oxalis corniculata		x	
O. dillenii		x	
GERANIACEAE			
Erodium texanum			x
Geranium carolinianum		x	
POLYGALACEAE			
Polygala alba	x		
RHAMNACEAE			

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
Condalia obtusifolia	x		
MALVACEAE			
Sphaeralcea coccinea			x
LOASACEAE			
Mentzelia decapetala			x
M. nuda	x		
M. oligosperma	x		
M. stricta			x
CACTACEAE			
Echinocactus texensis		x	
Echinocereus reichenbachii			x
Opuntia compressa			x
O. davisii		x	
O. leptocaulis	x		
ONAGRACEAE			
Calylophus hartwegii			
var. *fendleri*		x	
var. *pubescens*			x
Gaura filiformis	x		
G. parviflora		x	
G. sinuata		x	
G. suffulta		x	
Oenothera triloba		x	
Stenosiphon linifolius			x
UMBELLIFERAE			
Ammoselinum popei			x
Cymopterus macrorhizus			x
Lomatium daucifolium		x	
PRIMULACEAE			
Androsace occidentalis		x	
Samolus ebracteatus		x	
ASCLEPIADACEAE			

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
Asclepias engelmannia	x		
Matelea biflora			x
CONVOLVULACEAE			
Evolvulus nuttalianus		x	
HYDROPHYLLACEAE			
Nama hispidum		x	
N. stevensii	x		
Phacelia integrifolia	x		
BORAGINACEAE			
Lappula redowskii		x	
L. texana		x	
VERBENACEAE			
Verbena canadensis			x
V. halei		x	
LABIATAE			
Hedeoma drummondii			x
Monarda citriodora			x
Salvia azurea		x	
Scutellaria drummondii	x		
S. wrightii		x	
Teucrium laciniatum		x	
SOLANACEAE			
Chaemaesaracha conioides			x
Physalis lobata		x	
P. viscosa		x	
SCROPHULARIACEAE			
Castilleja citrina			x
Penstemon albidus		x	
P. fendleri	x		
PLANTAGINACEAE			
Plantago purshii			x

Taxon	Gypsum	Redbeds	Gypsum & Redbeds
RUBIACEAE			
Hedyotis humifusa		x	
CAMPANULACEAE			
Triodanis holzingeri		x	
COMPOSITAE			
Aphanostephus ramosissimus			x
Aster ericoides			x
A. leucelene			x
A. oblongifolius		x	
A. subulatus		x	
Berlandiera lyrata		x	
Gentaurea americana			x
Chrysopsis villosa			
var. *canescens*		x	
var. *stenophylla*	x		
Evax verna			x
Gaillardia pinnatifida			x
G. pulchella			x
G. suavis		x	
Grindelia squarrosa	x		
Haploesthes greggii	x		
Happlopappus spinulosis			x
Hymenoxys odorata			x
H. scaposa		x	
Liatris punctata			x
Lindheimera texana			x
Psilostrophe villosa	x		
Pyrrhopappus multicaulis		x	
Thelesperma megapotamicum		x	
Zinnia grandiflora			x

Of the 108 species occuring on the gypsum, the author discovered that only thirty were found exclusively on the gypsum. Seven of the thirty have herbarium records indicating occurance only on gypsum. They include:

> Condalia obtusifolia, Ephedra antisiphilitica, Haploesthes greggii, Hilaria mutica, Juniperus pinchoti, Nama stevensii, and Phacelia integrifolia.

Six other species which the author collected and observed only on gypsum appear to be good gyp indicators. These and the previous seven are considered gypsophiles and indicators of gypsum soils. They are:

> Astragalus missouriensis, A. racemosus, A. lotiflorus, Asclepias engelmannia, Penstemon fendleri, and Psilostrophe villosa.

The herbarium records of the above show one or two sheets which were not collected on gypsum.

Nine taxa found here only on the gypsum are reported also from limestone soils; especially the Arbuckle mountains and parts of Cimarron county. Russell (1961) states that calcareous soils free from sodium salts cannot have a pH exceeding 8.4, but the plants do not often do well in the soils because iron, manganese, boron and perhaps other trace elements are so insoluble in these soils. He also points out that potassium deficiency sometimes induces iron deficiency or chlorosis and that this is a characteristic trouble of calcareous soils. Calcareous soils in excess can be harmful. It seems then that plants common to the limestone and gypsum have adapted to the situation. The list of plants occuring almost exclusively on the gypsum and limestone are the following:

Aristida longiseta, Astragalus mollissimus, A. plattensis, Mentzelia nuda, M. oligosperma, Opuntia leptocaulis (1 sheet from limestone area), Polygala alba (also from prairie sites of deep soils), Scutellaria drummondii, and Tridens elongatus (also Wichita Mountains).

The other eight species of the thirty species were collected by the author only on gypsum, but do occur elsewhere. These are the following:

Atriplex canescens, Sporobolus airoides, S. cryptandrus, Chrysopsis villosa, var. stenophylla, Gaura parviflora, Grindelia squarrosa, Pellaea atropurpurea, and Schedonnardus paniculatus.

It should be noted that Sporobolus cryptandrus was most often observed on sand in the area, but was collected and observed on the gypsum several times. Schedonnardus paniculatus occurs in mostly sandy disturbed areas in the rest of the state. This grass was found in an area disturbed by gypsum mining. Atriplex canescens and Sporobolus airides occur only in saline sites in other parts of the state.

CHAPTER IX

ADDITIONS TO THE FLORA OF OKLAHOMA AND TAXA OF SPECIAL SIGNIFICANCE

Two introduced species Bromus willdenowii and Caesalpinia gilliesii are believed to be new additions to the state flora. No specimens are deposited in the two large herbaria of the state, the Bebb Herbarium at the University of Oklahoma and the Oklahoma State Herbarium. Caesalpinia gilliesii (Acc. no. 908) is a native of South America and is often found as an escape in central and West Texas. The species was found growing on the floodplain of the Red River, R20W, T2S, Sec. 11, and several individual shrubs were growing in the area. The plant was most likely cultivated for its showy flowers at the old homestead and escaped to the floodplain.

The distinctions between Bromus willdenowii and Bromus unioloides have been previously discussed by Raven (1960) and Beetle (1972). The species are very closely related, but the author believes Acc. no. 668 to be B. willdenowii. The species is a native of South America and according to Gould (1965) is quite common on the coast of Texas. The species was introduced into the United States as a forage grass and apparently has escaped in many areas. It is distinguished from B. unioloides on the basis of spikelet color, lemma length, and arrangement of spikelets.

In addition to the additions to the state flora, eighteen other

taxa are considered somewhat significant. These specimens are represented by six or less sheets in the Oklahoma State Herbarium.

Asclepias arenaria Torr. (Acc. no. 953). This species is represented by three sheets but is a widespread species in the Plians country of Texas. The plants seem to occur sporadically, therefore they could have been easily missed by collectors making one trip into the area.

Asclepias engelmanniana Woods. Acc. no. 986). This taxon is represented by five sheets and is very closely related to A. stenophylla. The two are quite difficult to delimit, therefore some of the herbarium material may be misidentified. This taxon is interesting in that it was only found on the gypsum soils in the study area.

Aphanostephus ramosissimus Buckl. (Acc. no. 670). This taxon is very similar in aspect to A. skirrhobasis and A. pilosus. It actually seems quite abundant in the area and has probably been overlooked by collectors due to the similar appearance of its relatives.

Atriplex canescens (Pursh) Nutt. (Acc. no. 841). Although only four sheets are in the herbarium, this species is widespread on alkaline soils in Texas. It was only found on gypsum soils in the study area.

Berlandiera lyrata Benth. var. lyrata (Acc. no. 711). Although this species is represented by only six sheets in the OSU herbarium, it is well represented in the Bebb herbarium. However, this taxon has been previously collected in Cimarron county in Oklahoma. This is quite a range extension for the state, but is not too unlikely in that the species occurs in the Texas Panhandle.

Chilopsis linearis (Cav.) Sweet. (Acc. no. 955). This taxon is represented by one sheet and was collected as a member of a shelter belt in Caddo county. This collection was also made in a shelter belt. The plant is native in the Trans-Pecos of Texas.

Echinocactus texensis Hopffer. (Acc. no. 726). There are no sheets of this species from Oklahoma in the OSU herbarium. Waterfall (1969) lists the species as occuring in the state. Correll and Johnston (1970) give a very limited distribution for the species in Texas and Mexico. The species was observed only one time in the study area in a mesquite grassland area near Eldorado. It seems to be a relatively rare species.

Echinocereus reichenbachii (Terscheck) Haage (Acc. no. 1109). This species is represented by three sheets, but is actually quite common in the study area. It probably has not been collected more often due to the difficulty in pressing and preserving cacti.

Haploethes greggii Gray Acc. no. 984). This taxon is represented by five sheets. It is an apparent gypsum endemic and has probably not been collected more often in the state because the gypsum areas have not been well collected.

Hedyotis humifusa Gray (Acc. no. 664). Although there are only two sheets represented of this species, it is quite common in the plains country of Texas. Most likely it has been overlooked by plant collectors because it is very inconspicuous.

Helenium microcephalum DC. (Acc. no 932). Four sheets of this species are represented and are all from the southwestern part of the state. The plant also occurs in seasonally moist areas. Combining these two factors, the species has most likely just been overlooked.

Hilaria mutica (Buckl.) Benth. (Acc. no. 927). This species was only found on the gypsum soils in the study area and only occured on two of the collection sites. However, it is locally quite abundant.

Matelea biflora (Raf.) Woods. (Acc. no. 853). There is only one sheet represented in the herbarium. This plant was only observed in two localities and was not abundant either place. It could quite easily be overlooked by a plant collector also because it blends in with the vegetation surrounding it.

Opuntia davisii (Engelm.) L. (Acc. no. 996). There is one collection of this species represented in the herbarium. It was seen only at one location by the author. Also, the spines are approximately four centimeters long and are very painful and make the specimen difficult to press so it has probably been passed by by many collectors.

Opuntia leptocaulis DC. (Acc. no 935). This species is quite often seen in the study area and has probably not been collected more often due to the difficulty in pressing.

Setaria leucophila (Scribn. & Merr.) K. Schum. (Acc. no. 1022). There is one representative of this species and is reported by Correll and Johnston (1970) to occur on the Rio Grande Plains, Trans-Pecos and Plains Country of Texas. Most likely the taxon has just extended its range into southwestern Oklahoma.

Triodanis holzingeri McVaugh. (Acc. no. 767). There are no sheets of this species in the herbarium, but is reported by Waterfall (1969) to occur in the state. Correll and Johnston (1970) report that it occurs in open plains therefore it is probably not rare, just overlooked by collectors.

Triodanis perfoliata (L.) Nieuw. (Acc. no. 877). There are only three collections of this taxon, but the plant seems quite weedy, therefore it has probably been overlooked as unimportant to collect.

CHAPTER X

LIST OF TAXA

The following is a list of vascular plants of the redbed plains and gypsum areas of southwestern Oklahoma based on specimens collected by the author and deposited in the Oklahoma State Herbarium and the Bebb Herbarium of the University of Oklahoma. In addition, twenty-six taxa collected by previous workers and four observed but not collected are included and so indicated. Each taxon is listed alphabetically within its family and families are listed in order according to the Engler-Prantl classification scheme. Nomenclature follows that of Correll and Johnston (1970) and Waterfall (1969).

MARSILEACEAE

Marsilea mucronata A. Br.

POLYPODIACEAE

Pellaea atropurpurea (L.) Link var. *atropurpurea*

CUPRESSACEAE

Juniperus pinchoti Sudw. U. T. Waterfall (11261) April 4, 1953
J. virginiana L.

GNETACEAE

Ephedra antisiphilitica Berland.

TYPHACEAE

Typha angustifolia L.

GRAMINEAE (POACEAE)

Agropyron smithii Rydb. var. smithii

Andropogon gerardii Vitman var. gerardii
A. hallii Hack.
A. ischaemum L.
A. saccharoides Sw.
A. scoparius Michx.

Aristida fendleriana Steud.
A. longiseta Steud.
A. oligantha Michx.
A. purpurea Nutt.
A. wrightii Nash

Arundo donax L.

Avena sativa L.

Bouteloua barbata Lag. U. T. Waterfall (8729) August 26, 1948
B. curtipendula (Michx.) Torr.
B. gracilis (Willd. ex H. B. K.) Lag ex Griffiths
B. hirsuta Lag.

Bromus japonicus Thunb.
B. tectorum L.
B. unioloides H. B. K.
B. willdenowii Kunth.

Buchloe dactyloides (Nutt.) Engelm.

Calamovilfa gigantea (Nutt.) Scribn. & Merr.

Cenchrus pauciflorus Benth.

Chloris cucullata Bisch.
C. verticillata Nutt.

Cynodon dactylon (L.) Pers.

Digitaria sanguinalis (L.) Scop

Distichlis spicata L. var. stricta (Torr.) Beetle

Echinochloa crusgalli (L.) Beauv.

Elymus canadensis L.
E. virginicus L.

Eragrostis barrelieri Daveau
E. cilianensis (All.) E. Mosher
E. curvula (Schrad.) Nees Observed only
E. oxylepis (Torr.) var. oxylepis
E. trichodes (Nutt.) Nash var. pilifera (Scheele) Fern.

Erioneuron pilosum (Buckl.) Nash

Hilaria mutica (Buckl.) Benth.

Hordeum pusillum Nutt.

Leptoloma cognatum (Schultes) Chase

Muhlenbergia arenicola Buckl. G. W. Stevens (1111) June 21, 1913
M. asperifolia (Nees & Mey.) Parodi U. T. Waterfall August 26, 1948

Panicum capillare L. var. capillare
P. reverchonii Vasey U. T. Waterfall (7774) June 3, 1948
U. T. Waterfall (7802) June 5, 1948
P. texanum Buckl.
P. virgatum L.

Phalaris caroliniana Walter

Poa arachnifera Torr.

Polypogon monspeliensis (L.) Desf.

Schedonnardus paniculatus (Nutt.) Trel.

Setaria lutescens (Wiegel) F. T. Hubb.
S. leucophila (Scribn. & Merr.) K. Schum.
S. viridis (L.) Beauv.

Sitanion hystrix (Nutt.) J. G. Smith J. G. Smith (199) June 8, 1931
U. T. Waterfall (8954) June 14, 1949

Sorghastrum nutans (L.) Nash

Sorghum halapense (L.) Pers.

Sporobolus airoides Torr.
S. asper (Michx.) Kunth
S. cryptandrus (Torr.) Gray
S. giganteus Nash R. J. Tyrl (883) & S. C. Barber September 28, 1974

Tridens albescens (Vasey) Woot. & Standl.

T. elongatus (Buckl.) Nash
T. flavus (L.) Hitch.

Triticum cylindricum Ces.

CYPERACEAE

Cyperus uniflorus Torr. & Hook.

Eleocharis compressa Sulliv.
E. macrostachya Britt.

Scirpus americanus Pers. var. americanus

COMMELINACEAE

Commelina erecta L. var. erecta

Tradescantia occidentalis (Britt.) Smyth
T. ohiensis Raf. forma ohiensis

LILIACEAE

Allium drummondii Regel

Androstephium coeruleum (Scheele) Greene forma coeruleum

Nothoscordum bivalve (L.) Britton

Yucca glauca Nutt. var. glauca

IRIDACEAE

Sisyrinchium angustifolium Miller

SALICACEAE

Populus deltoides Marsh.

Salix nigra Marsh.

FAGACEAE

Quercus havardii Rydb.

ULMACEAE

Celtis laevigata Willd.
C. occidentalis L.
C. reticulata Torr.

Ulmus americana L.

MORACEAE

Maclura pomifera (Raf.) Schneider

Morus alba L.

POLYGONACEAE

Eriogonum annuum Nutt.
E. longifolium Nutt. var. longifolium

Polygonum bicorne Raf.
P. lapathifolium L.

Rumex altissimus Wood
R. crispus L.
R. hymenosepalus Torr.

CHENOPODIACEAE

Atriplex argentea Nutt. U. T. Waterfall (8733) August 25, 1948
A. canescens (Pursh) Nutt.

Chenopodium album L.
C. incanum (Wats.) Heller U. T. Waterfall (8984) June 14, 1949

Kochia scoparia (L.) Schrad.

Salsola kali L. var. tenuifolia Tausch

Suaeda depressa (Pursh) Wats.

AMARANTHACEAE

Amaranthus palmeri S. Wats.

Tidestromia lanuginosa (Nutt.) Standl.

NYCTAGINACEAE

Abronia fragrans Nutt. R. J. Tyrl (855), C. McDonald, & P. Risk May 15, 1974

Mirabilis linearis (Pursh) Heimerl var. linearis

Selinocarpus diffusus Gray U. T. Waterfall (9001) June 15, 1949

PORTULACACEAE

Portulaca mundula I. M. Johnston

CARYOPHYLLACEAE

Arenaria serpyllifolia L.

Cerastium brachypodum (Engelm.) Robinson

Silene antirrhina L. forma antirrhina

ILLECEBRACEAE

Paronychia jamesii T. & G.

RANUNCULACEAE

Anemone caroliniana Walt. forma violacea Clute

Delphinium virescens Nutt. var. pernardii (Kunth) Perry

Myosurus minimus L. var. interior Boivin

PAPAVERACEAE

Argemone polyanthemos (Fedde) G. B. Ownb.

CRUCIFERAE (BRASSICACEAE)

Camelina microcarpa Andrz.

Capsella bursa-pastoris (L.) Medic

Descurainia pinnata (Walt.) Britt. var. osmiarum (Cockerell) Shinners
D. sophia (L.) Webb

Dithyrea wislizenii Engelm. var. palmeri Payson

Draba brachycarpa Nutt.

Erysimum repandum L.

Lepidium austrinum Small
L. virginicum L. var. medium (Greene) C. L. Hitchc.

Lesquerella gordonii (Gray) Wats.

Sibara virginica (L.) Rollins

ROSACEAE

Prunus angustifolia Marsh.

LEGUMINOSAE (FABACEAE)

Acacia hirta T. & G.

Astragalus lindheimeri Gray
A. lotiflorus Hook.
A. missouriensis Nutt.
A. mollissimus Torr.
A. nuttallianus DC. var. nuttallianus
A. plattensis Nutt.
A. racemosus Prush

Caesalpinia gilliesii (Hook.) Benth.

Cassia fasciculata Michx.

Dalea aurea Nutt. ex Pursh
D. enneandra Nutt. ex Fraser

Desmanthus illinoensis (Michx.) MacM.

Gleditsia triacanthos L.

Hoffmanseggia densiflora Benth.
H. jamesii T. & G.

Indigofera miniata Ortega var. leptosepala (Nutt.) Turner

Medicago minima (L.) Bartilini
M. sativa L.

Melilotus officinalis (L.) Lam.

Mimosa borealis Gray

Petalostemum candidum Willd. var. oligophyllum (Torr.) Hermann
P. villosum Nutt.

Prosopis glandulosa Torr. var. glandulosa

Psoralea cuspidata Pursh
P. tenuiflora Pursh

Schrankia uncinata Willd.

Strophostyles leiosperma (T. & G.) Piper

Vicia ludoviciana Nutt.

KRAMERIACEAE

Krameria lanceolata Torr.

LINACEAE

Linum lewisii Pursh var. pratense Norton
L. rigidum Pursh var. rigidum

OXALIDACEAE

Oxalis corniculata L.
O. dillenii Jacq.

GERANIACEAE

Erodium cicutarium (L.) L'Her
E. texanum Gray

Geranium carolinianum L.

ZYGOPHYLLACEAE

Kallstroemia intermedia Rydb.

Tribulus terrestris L.

POLYGALACEAE

Polygala alba Nutt.

EUPHORBIACEAE

Gnidoscolus texanus (Muell. Arg.

Groton texensis (Klotzsch) Muell. Arg.

Euphorbia albomarginata T. & G.
E. dentata Michx. forma cuphosperma (Engelm.) Fern.
E. glyptosperma Engelm.
E. hexagona Nutt.
E. lata Engelm.
E. marginata Pursh
E. missurica Raf.
E. spathulata Lam.

Reverchonia arenaria Gray U. T. Waterfall (8340) July 21, 1948

Stillingia sylvatica L.

ANACARDIACEAE

Rhus aromatica Ait. var. flabelliformis Shinners
R. microphylla Engelm. U. T. Waterfall (9447) May 13, 1950
R. radicans L. var. radicans

SAPINDACEAE

Sapindus drummondii H. & A.

RHAMNACEAE

Condalia obtusifolia (Hook.) Weberb.

VITACEAE

Vitis acerifolia Raf.

MALVACEAE

Callirhoe involucrata (Nutt. ex Torr.) Rydb. var. involucrata
C. involucrata (Nutt. ex Torr.) Rydb. var. linearíloba (T. & G.) Gray
C. leiocarpa Martin

Sida leprosa (Ort.) K. Schum. var. hederacea (Dougl) K. Schum.
U. T. Waterfall (9016) June 16, 1949
S. physocalyx Gray U. T. Waterfall (8996) June 15, 1949

Sphaeralcea coccinea (Nutt. in Fras.) Rydb.

TAMARICACEAE

Tamarix gallica L.

LOASACEAE

Mentzelia decapetala (Pursh) Urban & Gilg
M. nuda (Pursh) T. & G.
M. oligosperma Nutt.
M. stricta (Osterhout) Stevens ex Jeffs and Little

CACTACEAE

Echinocactus texensis Hopf.

Echinocereus reichenbachii (Tersch.) Haage

Opuntia compressa (Salisb.) Macbr.
O. davisii Engelm. & Bigel.
O. leptocaulis DC.

LYTHRACEAE

Ammania coccinea Rottb.

ONAGRACEAE

Calylophus hartwegii (Benth.) Raven subsp. fendleri (Gray) Towner & Raven
C. hartwegii (Benth.) Raven subsp. pubescens Towner & Raven
C. serrulatus (Nutt.) Raven

Gaura filiformis Small
G. parviflora Dougl.
G. sinuata Ser.
G. suffulta Engelm.
G. villosa Torr. subsp. villosa

Oenothera laciniata Hill var. grandiflora (Wats.) Robinson
O. rhombipetala T. & G.
O. speciosa Nutt.
O. triloba Nutt.

Stenosiphon linifolius (Nutt.) Heynh.

UMBELLIFERAE (APIACEAE)

Ammoselinum popei T. & G.

Cymopterus macrorhizus Buckl.

Daucus pusillus Michx.

Eurytaenia texana T. & G. U. T. Waterfall (11981) June 4, 1954

Lomatium daucifolium (Nutt.) Coult. & Rose

Torilis arvensis (Huds.) Link

PRIMULACEAE

Androsace occidentalis Pursh

Samolus ebracteatus H. B. K.

PLUMBAGINACEAE

Limonium limbatum Small U. T. Waterfall (8319) July 21, 1948

OLEACEAE

Fraxinus pennsylvanica Marsh.

ASCLEPIACACEAE

Asclepias asperula (Dcne.) Woods. var. decumbens (Nutt.) Shinners
A. arenaria Torr.
A. engelmanniana Woods.

Cynanchum laeve (Michx.) Pers.

Matelea biflora (Raf.) Woods.

CONVOLVULACEAE

Convolvulus arvensis L.

Cressa truxillensis H. B. K. U. T. Waterfall (9423) May 13, 1950

Cuscuta sp. Observed only.

Evolvulus nuttallianus R. & S.

POLEMONIACEAE

Ipomopsis longiflora (Torr.) V. Grant

HYDROPHYLLACEAE

Nama hispidum Gray
N. stevensii Hitchc.

Phacelia integrifolia Torr.

BORAGINACEAE

Cryptantha minima Rydb.

Lappula redowskii (Hornem.) Greene var. occidentalis (Wats.0 Rydb.
L. texana (Scheele) Britton

Lithospermum incisum Lehm.

VERBENACEAE

Verbena bracteata Lag. & Rodr.

V. canadensis (L.) Britt.
V. halei Small
V. plicata Greene
V. pumila Greene

LABIATAE (LAMIACEAE)

Hedeoma drummondii Benth.

Lamium amplexicaule L. forma amplexicaule

Monarda citri odora Gerv. ex Lag.
M. punctata L. var. occidentalis (Epl.) Palm. & Steyerm.

Salvia azurea Lam. var. grandiflora Benth.

Scutellaria drummondii Benth.
S. wrightii Gray forma wrightii

Teucrium canadense L. var. virginicum (L.) Eat.
T. laciniatum Torr.

SOLANACEAE

Chamaesaracha conioides (Moric.) Britt.

Datura meteloides DC.

Lycium berlandieri Dunal U. T. Waterfall (8994) June 15, 1949

Nicotiana trigonophylla Dunal U. T. Waterfall (7801) June 5, 1948

Physalis lobata Torr. var. lobata
P. viscosa L. var. cinerascens (Dunal) Waterfall

Solanum elaeagnifolium Cav. forma elaeagnifolium
S. rostratum Dunal
S. torreyi Gray forma torreyi
S. triflorum Nutt. G. W. Stevens (1096) June 23, 1913

SCROPHULARIACEAE

Castilleja citrina Pennell

Penstemon albidus Nutt.
P. cobea Nutt.
P. fendleri T. & G.

Veronica arvensis L.
V. peregrina L. var. xalapensis (H. B. K.) St. John & Warren

BIGNONIACEAE

Catalpa bignonioides Walt.

Chilopsis linearis (Cav.) Sweet.

MARTYNIACEAE

Proboscidea louisianica (Miller) Thel. Observed only.

PLANTAGINACEAE

Plantago purshii R. & S. var. spinulosa (Dcne.) Shinners
P. rhodosperma Dcne.
P. virginica L.
P. wrightiana Dcne.

RUBIACEAE

Hedyotis humifusa Gray
H. nigricans (Lam.) Fosb.

CUCURBITACEAE

Cucurbita foetidissima H. B. K.

Ibervillea lindheimeri (Gray) Greene U. T. Waterfall (9406) May 13, 1950

CAMPANULACEAE

Triodanis holzingeri McVaugh
T. perfoliata (L.) Nieuw.

COMPOSITAE (ASTERACEAE)

Achillea millefolium L.

Ambrosia psilostachya DC. var. lindheimeriana (Scheele) Blankenship
A. trifida L. var. texana Scheele

Aphanostephus pilosus Buckl.
A. ramosissimus DC.
A. skirrhobasis (DC.) Trel.

Artemisia filifolia Torr.
A. ludoviciana Nutt. var. ludoviciana

Aster ericoides L.
A. leucelene Blake
A. oblongifolius Nutt.
A. subulatus Michx. var. ligulatus Shinners

Baccharis salicina T. & G.
B. texana (T. & G.) Gray U. T. Waterfall (8361) July 23, 1948

Berlandiera lyrata Benth. var. lyrata

Centaurea americana Nutt.

Chrysopsis villosa (Pursh) Nutt. var. canescens Gray
C. villosa (Pursh) Nutt. var. stenophylla Gray

Cirsium texanum Buckl.

Conyza canadensis (L.) Cronq. var. glabrata (Gray) Cronq.

Engelmannia pinnatifida T. & G.

Evax verna Raf.

Flaveria campestris J. R. Johnston U. T. Waterfall (8735) August 25, 1948

Gaillardia pinnatifida Torr.
G. pulchella Fouq.
G. suavis (Gray & Engelm.) Britt. & Rusby

Grindelia squarrosa (Pursh) Dunal var. nuda (Wood) Gray

Gutierrezia dracunculoides (DC.) Blake
G. sarothrae (Pursh) Britt. & Rusby

Haploesthes greggii Gray var. texana (Coulter) Johnston

Haplopappus ciliatus (Nutt.) DC.
H. divaricatus (Nutt.) Gray var. hookerianus (T. & G.) Waterfall
H. spinulosis (pursh) DC.

Helenium microcephalum DC.

Heterotheca latifolia Buckl.

Helianthus annuus L.
H. petiolaris Nutt.

Hymenopappus scabiosaeus L'Her var. corymbosus (T. & G.) Turner
H. tenuifolius Pursh U. T. Waterfall (7307) June 28, 1947

Hymenoxys odorata DC.
H. scaposa (DC.) Parker var. scaposa

Iva ciliata Willd.

Liatris punctata Hook. var. nebraskensis Gaiser
L. punctata Hook. var. punctata

Lindheimera texana Gray & Engelm.

Lygodesmia aphylla DC. var. texana T. & G.

Palafoxia sphacelata (Nutt. ex Torr.) Cory

Pluchea purpurascens (Sw.) DC.

Psilostrophe villosa Rydb.

Pyrrhopappus grandiflorus Nutt.
P. multicaulis DC. var. geiseri (Shinners) Northington

Ratibida columnifera (Nutt.) E. & S. forma columnifera
R. tagetes (James) Barnh. G. W. Stevens (1080) June 21, 1913

Rudbeckia hirta L. var. pulcherrima Farwell

Senecio riddellii T. & G.

Silphium laciniatum Torr. var. laciniatum

Solidago gigantea Ait. var. leiophylla Fern.
S. missouriensis Nutt. var. fasciculata Holz.

Sonchus asper (L.) Hill, forma glandulosus Beckh.

Thelesperma filifolium (Hook.) Gray
T. megapotamicum (Spreng.) Kuntze

Tragopogon major Jacq.

Verbesina encelioides (Cav.) B. & H.

Vernonia baldwinii Torr. var. interior (Small) Schub.
V. marginata (Torr.) Raf. Bruce Harkins (91) October 17, 1970

Xanthisma texanum DC. var. drummondii (T. & G.) Gray

Xanthium strumarium L. var. canadense (Mill.) T. & G.
X. strumarium L. var. glabratum (DC.) Cronq.

Zinnia grandiflora Nutt.

CHAPTER XI

TABULAR VIEW OF THE FAMILIES

The following is an alphabetical tabulation of the taxa enumerated in Chapter X.

Families	Genera	Species	Species and Subordinate Taxa
Amaranthaceae	2	2	2
Anacardiaceae	1	3	3
Asclepiadaceae	3	5	5
Bignoniaceae	2	2	2
Boraginaceae	3	4	4
Cactaceae	3	5	5
Campanulaceae	1	2	2
Caryophyllaceae	3	3	3
Chenopodiaceae	5	7	7
Commelinaceae	2	3	3
Compositae	45	66	69
Convolvulaceae	4	4	4
Cruciferae	9	11	11
Cucurbitaceae	2	2	2
Cupressaceae	2	2	2
Cyperaceae	3	4	4
Euphorbiaceae	5	12	12

Families	Genera	Species	Species and Subordinate Taxa
Fagaceae	1	1	1
Geraniaceae	2	3	3
Gnetaceae	1	1	1
Gramineae	35	65	65
Hydrophyllaceae	2	3	3
Illecebraceae	1	1	1
Iridaceae	1	1	1
Krameriaceae	1	1	1
Labiatae	6	9	9
Leguminosae	18	29	29
Liliaceae	4	4	4
Linaceae	1	2	2
Loasaceae	1	4	4
Lythraceae	1	1	1
Malvaceae	3	5	6
Marsileaceae	1	1	1
Martyniaceae	1	1	1
Moraceae	2	2	2
Nyctaginaceae	3	3	3
Oleaceae	1	1	1
Onagraceae	4	12	13
Oxalidaceae	1	2	2
Papaveraceae	1	1	1
Plumbaginaceae	1	1	1
Plantaginaceae	1	4	4
Polemoniaceae	1	1	1

Families	Genera	Species	Species and Subordinate Taxa
Polygalaceae	1	1	1
Polygonaceae	3	7	7
Polypodiaceae	1	1	1
Portulaceae	1	1	1
Primulaceae	2	2	2
Ranunculaceae	3	3	3
Rhamnaceae	1	1	1
Rosaceae	1	1	1
Rubiaceae	1	2	2
Salicaceae	2	2	2
Sapindaceae	1	1	1
Scrophulariaceae	3	6	6
Solanaceae	6	10	10
Tamaricaceae	1	1	1
Typhaceae	1	1	1
Ulmaceae	2	4	4
Umbelliferae	6	6	6
Verbenaceae	1	5	5
Vitaceae	1	1	1
Zygophyllaceae	2	2	2

TOTALS

Families	Genera	Species	Species and Subordinate Taxa
63	230	354	359

CHAPTER XII

SUMMARY

During the collecting season of 1975, five hundred and forty-two accessions were made by the author and the identified specimens deposited in the Oklahoma State and the Bebb herbaria. From these specimens and twenty-six others collected by U. T. Waterfall and G. W. Stevens, a list of the vascular plants of the redbed plains and gypsum hills regions of southwestern Oklahoma was compiled. The list contains 63 families, 230 genera, 354 species, and 359 different taxa. 30 species were found to grow only on gypsum soils. Approximately 60 % of the taxa are from seven families: Compositae, 69; Gramineae, 65; Leguminosae, 29; Onagraceae, 13; Euphorbiaceae, 12; Cruciferae, 11; and Solanaceae, 10. Two introduced species Bromus willdenowii and Caesalpinia gilliesii are listed as additions to the state flora and eighteen taxa are discussed as being infrequently collected and especially significant.

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