

A VEGETATION ANALYSIS OF A PIMPLED PRAIRIE IN NORTHEASTERN OKLAHOMA

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The effect of pimple mound microrelief on the vegetation of a tall grass prairie was considered. Taxonomic analysis of the vegetation affirmed the observation that mound and intermounds support communities with differing species composition. The difference in the percent cover by living vegetation on mounds and intermounds was determined not to be statistically significant. The physical composition of the soil in the two regions was found to be similar. Two factors are suggested as influencing the differences in mound and intermound vegetation: that mound soils can provide more available water to plants than can intermound soils, and that mounds, but not intermounds, contain the burrows of small mammals and are modified by their presence.

INTRODUCTION

Pimple Mounds are low, regular domes of soil that establish a microrelief pattern common on prairies in eastern Oklahoma (Figs. 1, 2). Similar mounds occur throughout the United States (Fig. 3), on both level and gently sloping terrain (Knechtel 1952). Mounds have also been described from South America (Scheffer 1958) and Australia (Prescott, 1931). They are variously called natural mounds and hog wallow relief in California (Branner, 1905), Mima mounds in Washington (Dalquest and Scheffer, 1942), and pimples

prairies in the South including Oklahoma (Knechtel, 1952; Barclay, 1938). The pimples prairies of Oklahoma are no older than late Pleistocene (Knechtel, 1952).

Mounds have been examined with basal diameters ranging from 10 feet (3.05 m) to 130 feet (39.6 m) (Ross et al., 1968) and heights ranging from two feet (0.61 m) to seven feet (2.13 m) (Dalquest and Scheffer, 1942). The dimensions of eastern Oklahoma mounds correspond to the lower figures of these ranges (Knechtel, 1952).



Figure 1 Study site showing pimpled microrelief, April 1972



Figure 2 Pimple mound, demonstrating greener vegetation than the surrounding prairie, late June 1972

Pimple mounds typically consist of unstratified soil, variously characterized as "loess-like" (Knechtel, 1952) or extremely loose and friable (Ross et al., 1968); this dark material is responsible for most of the height of the mound and often rests on a clay pan which is lighter in color (fig. 4). Between the mounds is an intermound

furrow system. The interface between the soil and the subsoil does not demonstrate the pimpled microrelief; thus the mounds are features of the soil and not of the underlying strata; the soil of mound and intermound areas is similar in texture and composition (Melton, 1954).

Reference in scientific literature to natural mounds

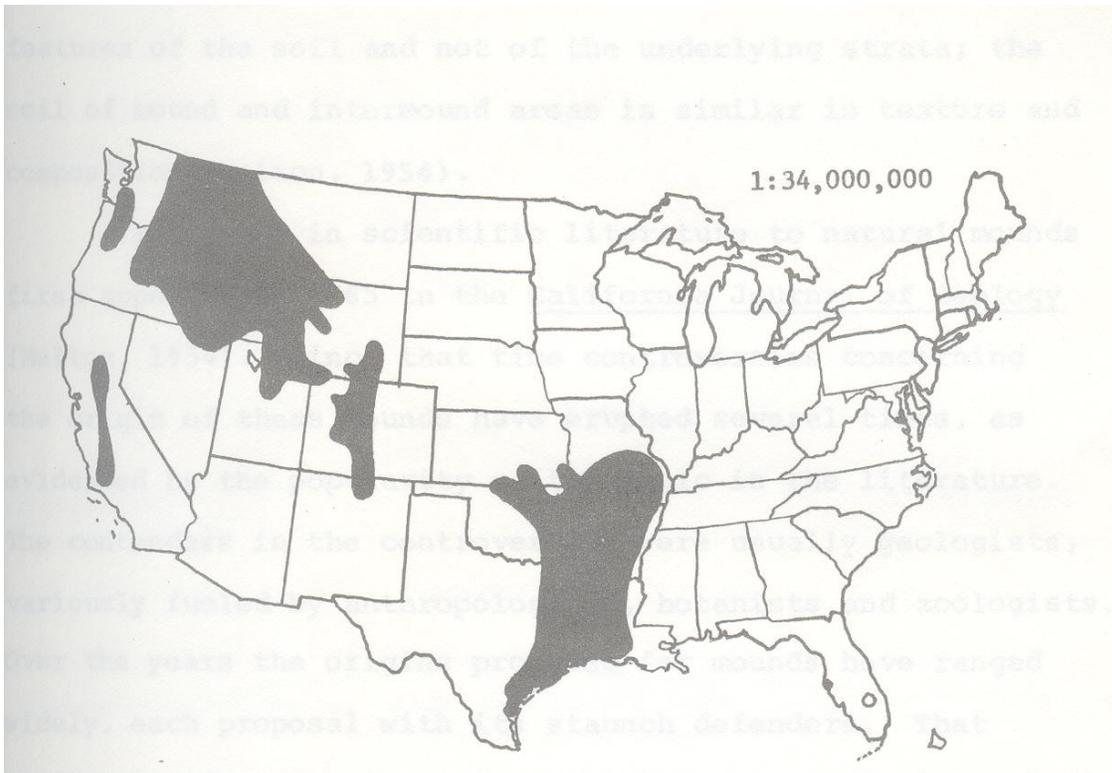


Figure 3 Shaded areas indicate the major regions in which pimple mounds occur in the United States (after Fenneman, 1931)

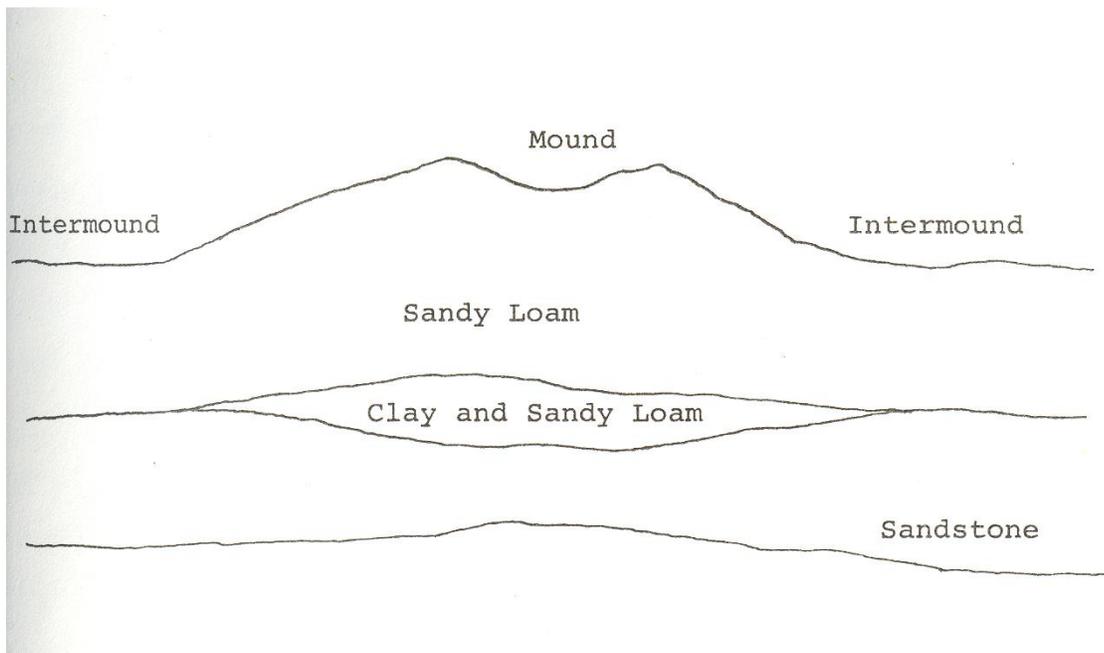


Figure 4 Stylized profile of a mound showing general shape and distribution of soil types. Note depression in mound center, probably due to disturbance by small mammals. Composite sketch from various authors (Scale 1:90)

first appeared in 1865 in the *California Journal of Geology* (Melton, 1954). Since that time controversies concerning the origin of these mounds have erupted several times, as evidenced by the popularity of the topic in the literature. The contenders in the controversies were usually geologists, variously fueled by anthropologists, botanists and zoologists. Over the years the origins proposed for mounds have ranged widely, each proposal with its staunch defenders. That fact that similar mounds occur in regions which vary greatly in geologic history, present geologic forces, climate, and flora and fauna has made it difficult to ascribe one origin to all mounds, as most authors have attempted to do. A discussion of the more prominent scientific hypotheses advanced for the origin of pimpled mounds is in order.

Campbell (1906) reviewed the suggestion that the pimple mounds were Indian burial mounds; the artifacts which usually characterize such sites have been found in a few mounds excavated in the South. However, artifacts are absent in most of the mounds throughout the country (Melton, 1954).

Veatch (1906) proposed that ants or termites

construct pimple mounds. The town ant, *Atta texana*, may create soil mounds in the south (Cain, 1974). These mounds are smaller in height and larger in diameter than typical pimple mounds; ants do not inhabit mounds in other regions of the country and evidence of previous occupations has not been found (Melton, 1954).

Some authors have suggested that mounds result from animal disturbance of an area. Dalquest and Scheffer (1942) and Scheffer (1958) asserted that, over long periods of time, pocket gophers; both recent and historic, form pimple hills. Ross et al. (1968) extended this view to include toads, ground squirrels and badgers as mound constructors. The primary basis for this proposed origin was, in each instance, the modified soil characters, i.e., lower bulk density, lack of soil structure, increased water permeability and particle size in mounds, when compared to the surrounding prairie. These authors maintain that these changes are possible with the normal activities of the suggested animals. Grant (1948) systematically discredits this proposal; his rejection of the hypothesis is based on the subjective interpretation of the pocket gopher behavior and the inconsistencies in

Scheffer's assertions. It seems reasonable that, rather than constructing a mound to avoid a high water table, as Ross et al. (1968) suggest, rodents utilized an existing mound structure, formed by some other means.

A series of physical explanations for the creation of pimple mounds has been advanced, including suggestions that the mounds: are coppices or sand dunes; result from fossil mud lumps; are protected from erosion by cap rock; are the work of glaciers; are concretionary depositions of minerals from ground water; results from spring and gas vents. Melton (1954) discussed these and other at length, discrediting each as an origin which is generally applicable, though each may have influenced mound formation in a specialized locale.

Two physical hypotheses of pimple mound origin are noted as widely acceptable; both are based on the observation that pimple mounds are found in regions with at least a moderate rainfall. Krinitsky (1949) proposed that mounds are deposited by river currents during periods of high water, forming ridges; vegetation invades when the water recedes, establishes a soil and maintains the mound. This proposed origin is supported by observations that mounds lack the well

defined soil profile common in prairies, and that mounds are often found along ridges; however, Cain (1974) asserted that mounds do not occur along creeks or rivers or in alluvium.

Erosion is one of the simpler and more popular explanations for soil mounds (LeConde, 1974); Melton, 1929); Knechtel, 1952, Cain, 1974). Knechtel (1952) proposed that erosion is preceded and enhanced by the division of soil into prismatic blocks, due to seasonal desiccation and freezing. The blocks would then be worn down and rounded by erosion to produce pimple mounds. Melton (1954) suggested that weak, sandy soil erodes readily to produce gullies with walls which collapse easily and are rounded by rain and slumping to produce mounds. Aronow (1972) favored a two-phased formative process; firstly, a pluvial period marked by high run-off to initiate mounds; secondly, a period of low rainfall and high local winds, so that vegetation on the mounds traps the blowing soil, thus creating the thick A-horizon which is characteristic of pimple hills. Cain (1974) postulated that erosion around tree cover produces pedestal trees; with demise of the trees, the eroded tree pedestals remain, forming small pimple mounds.

Melton (1954) concluded that one is brought by default to erosion as the creative force behind pimple hills, since none of the other proposed phenomena is sufficiently widespread or continuous to account for the number of pimple mounds.

The vegetation of pimples prairies has been examined and analyzed by several workers who provide varying descriptions. Melton (1954) discussed and concurred with Campbell's (1906) observations; both ascribed to intermounds a greater fertility, evidence by a darker color, higher water content, and higher stands of vegetation when compared to mounds.

McGinnies (1960) took the opposing view that mounds are more fertile. He documented this assertion with experimental results of the herbage production of five species of grasses on mounds and intermounds in Colorado. McGinnies found that mounds yielded twice the dry weight herbage of the intermounds. Ross et al. (1968) observed that prairie mounds were dominated by either shrubs, forbs, or grasses, depending on the size of the mound and the amount of soil

disturbance by animal burrowing. Barclay (1938) reported some difference in the species of plants which occur on the mounds and intermounds in southeastern Oklahoma; notably, the genus *Drosera* occurs only between the mounds.

The purpose of this investigation was to study the effect of pimple mound microrelief on vegetation, particularly on species composition and on percentage cover. The study site selected is a tall grass prairie in the Cherokee Prairie Biotic District of Blair and Hubbell (1938). The prairie is approximately two miles West of Inola and four miles East of the Verdigris River on Oklahoma Highway 33, NW 1/4, S6, T 19N, R17E, Rogers County, Oklahoma (Fig. 5). At the time of the study the prairie was owned by K. V. Spainhower, who assured the author that for more than sixty years the prairie had been mowed but neither grazed nor plowed. This prairie was thus deemed to be in an undisturbed state, when compared to other sites available for study, and particularly amenable to a vegetation study.

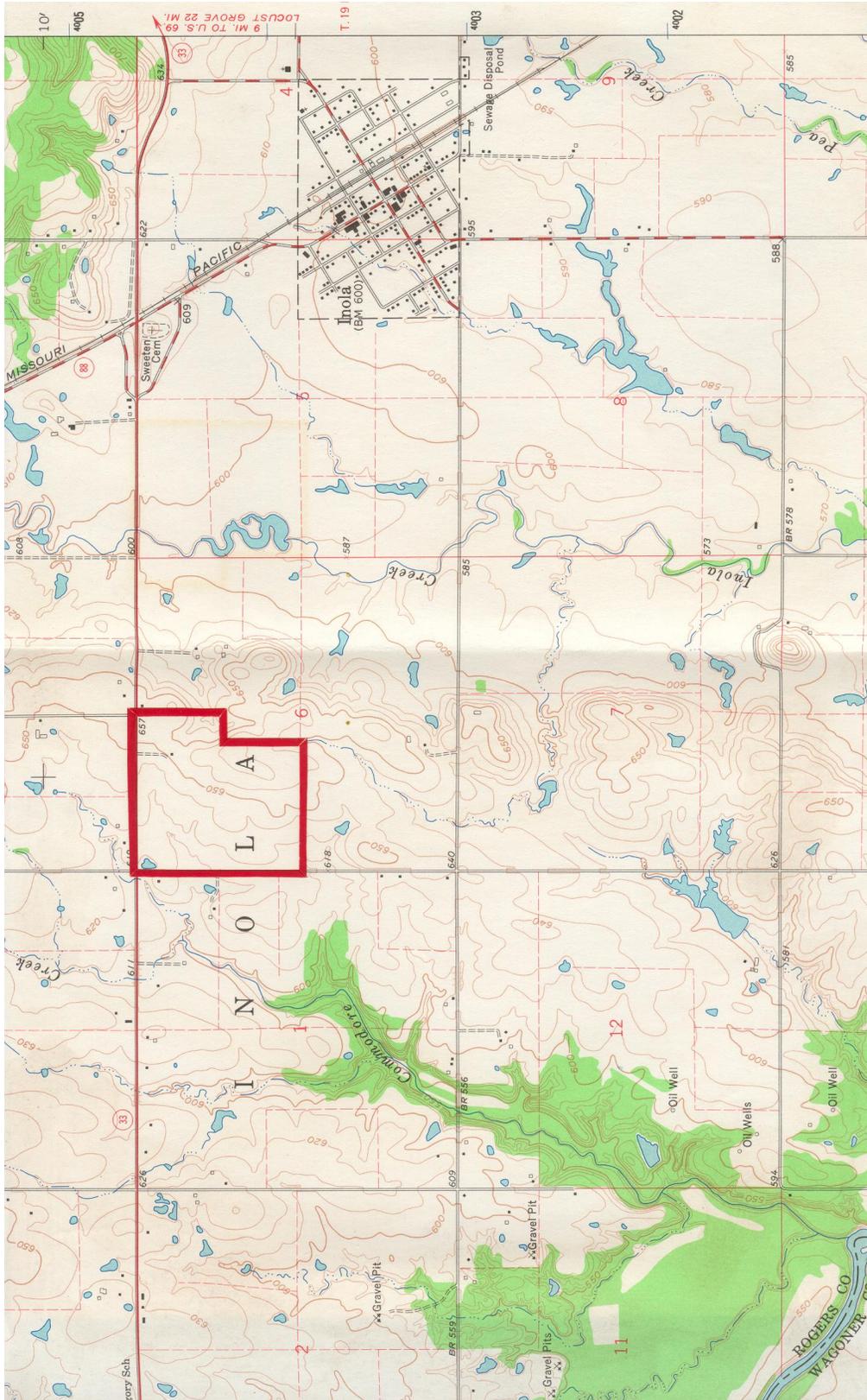


Figure 5 Location of study site with reference to the town of Inola and the Verdigris River. United States Geological Survey Topographic Map.

METHODS AND MATERIALS

The vegetation of mounds and intermounds was analyzed by the inclined point quadrat method (Tinney et al., 1937) using the basal contact modification (Whitman and Siggeirsson, 1954). The method was applied to each pimple mound in the following manner. The point frame was placed halfway up the eastern slope of a mound and readings taken from the ten pins; then the frame was moved five paces in a clockwise direction, again placed on the mound slope and read. This procedure was repeated ten times for a total of one-hundred points per mound. The different positionings of the frame formed a pattern which resembled the spokes on a wheel.

Similarly, data were gathered from the intermound region, which concentrically surrounded each mound considered. The frame was again positioned ten times, at ten pace intervals, providing one-hundred points per intermound region sampled.

Data were collected from eighteen mounds and intermound areas using the point frame, in April, June and July, 1972. The mounds considered were selected randomly. These data were tabulated and used to

determine percentage cover by vegetation.

Vascular plants of the study site were collected weekly, from mid-march to mid-July, 1972; when possible, plants were collected while blooming. Nomenclature follows Waterfall (1969). Upon collection, it was noted whether each species occurred on mounds, intermounds, or both. All plant specimens are contained in The University of Tulsa Herbarium.

The spatial relationship between the mounds on the prairie was mapped. The fence marking the southern boundary of the study site was designated as the primary reference line; mounds were mapped in relationship to this fence. The information for the map was obtained using a Brunton compass, corrected to true North. The heights of the mounds were measured in relation to each other and to the intermound surface. The slope of the intermound surface was also measured with the compass, and distances between the mounds with a metal tape.

Soil samples were collected from the surface to bedrock, from three mounds and corresponding intermound areas, using a hydraulic soil auger two inches in diameter. The auger was provided and

operated by Doc Polone of the Rogers County Soil Conservation Service, Claremore, Oklahoma. Soil cores collected in this manner were placed intact in troughs made of plastic pipe; the pipes, 2.5 inches (6.4 cm) in diameter, had been split lengthwise to accommodate the samples. Soil horizons were identified as definitively as possible, considering the color and macroscopic character of the soil. Fifty grams of soil from each horizon was characterized as to its physical composition, percentages of sand, silt and clay, by the hydrometer method (Bouyoucos, 1936).

The climatological data presented were provided by the United States Weather Bureau Office at Tulsa International Airport. Precipitation is based on records dating back to 1950 (Curry, 1970).

The statistical tests used were the point biserial correlation to analyze the percent cover data (Downie and Heath, 1974); and the two-factor mixed design analysis of variance to analyze the data relating to the physical composition of the soils (Winer, 1962).

RESULTS

Seventy-six species of vascular plants were collected from the study site. This collection

represents a total of twenty-eight families and sixty-three genera; species are listed phylogenetically in Table I. From this collection, twenty-five species (33%) were found only in mound habitats, twenty-nine species (38%) were collected only from intermound habitats, and twenty-two species (29%) occurred in both habitats. This relationship between species and habitat is presented in Table II. Of the species common to both habitats in the prairie, seven species (33%) were grasses; one-half the grasses were restricted to one habitat or the other.

Percent cover of the prairie by living vegetation in the two habitats is compared in Fig. 6. The percent cover value presented for each date is the mean value for the data collected on that date. By inspection, the data reveal that higher values of percent cover were obtained for mounds than for intermounds. This information was submitted to the point biserial statistic. The t statistic indicated that the relationship between the type of terrain, i.e., mound or intermound, and the percent cover values was not statistically significant ($t = 1.64, df = 32, p < .10$).

The low precipitation for the period preceding and

during this study in 1972 is presented and compared with that of the previous twenty years in Fig. 7.

The spatial relationship between the pimple mounds on the prairie considered in this study is shown in Fig. 8. The mounds were found primarily along a ridge, from which the prairie sloped westwardly with approximately 10% slope. In this prairie the mounds ranged from 16 feet (4.876 m) to 50 feet (15.24 m) in diameter and from 1.5 feet (0.457 m) to 3.0 feet (0.914 m) in height. Mounds varied in shape from irregularly eggshaped [40 feet (12.19 m) by 50 feet (15.24 m)] to nearly circular [26 feet (7.924 m) by 27 feet (8.229 m)]. There was generally noted a slight alignment down slope.

Soil depth and the approximate thickness of each horizon from three mounds and corresponding intermound areas are compared in Fig. 9. The physical composition of the soil from each horizon is summarized in Table III. The difference in the amount of sand in the three horizons was statistically significant ($F = 6.999$; $df = 2.8$; $p < .02$). Horizon C had less sand than either A or B. The difference in the amount of silt at the three horizons was statistically significant ($F = 47.794$; $df = 2.8$; $p < .001$). Horizon A

had more silt than either B or C. The difference in the amount of clay in the three horizons was statistically significant ($F = 7.335$; $df = 2.8$; $p < .02$). Horizon C had more clay than either A or B. When comparing soil from mounds with that of intermound areas, the difference in the percentages of sand, silt and clay was not statistically significant (Sand: $F = 1.813$; $df = 1.4$; $p < .25$), (Silt: $F = 3.460$; $df = 1.4$; $p < .15$), (Clay: $F = 1.041$; $df = 1.4$; $p < .4$).

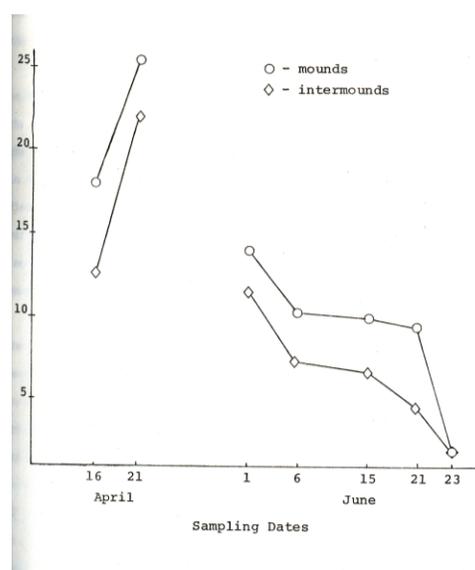


Figure 6 The percentage of cover by living vegetation of mounds (O), and intermounds (<>), determined with a point frame, basal contact modification.

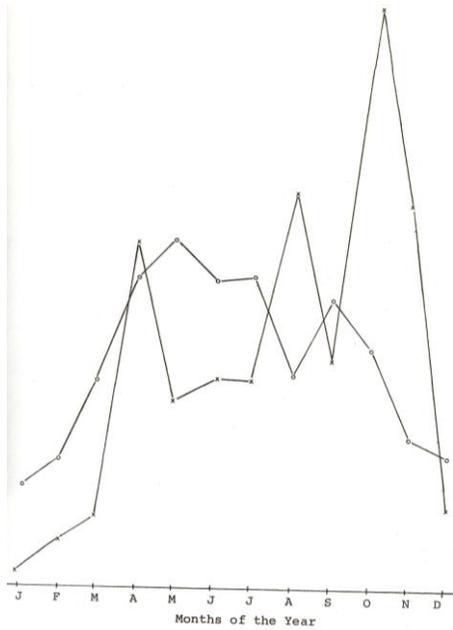


Figure 7 Monthly precipitation figures for 1972 (x), compared with monthly means calculated from 1951-1970 (o) for Tulsa County. From U.S. Weather Bureau.

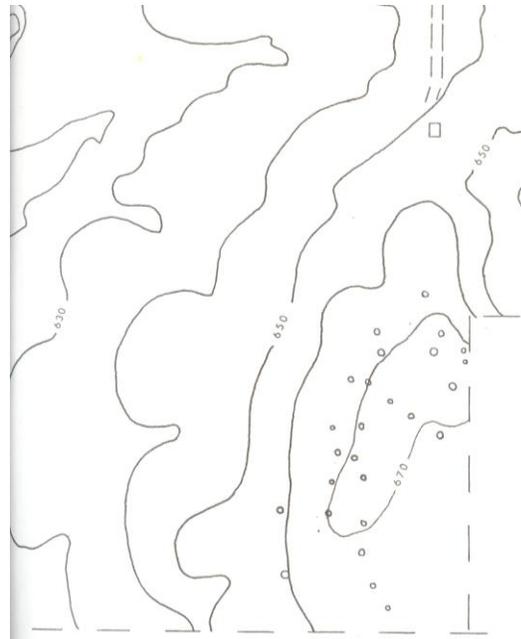


Figure 8 Distribution of mounds in the prairie studied. Note that the distribution pattern generally follows the higher contour lines. (Scale 1:17,352)

DISCUSSION

One factor to be considered to interpreting the data presented is the distribution of the rainfall for the duration of the experiment; for this period, the precipitation was lower than average which produced a marked effect on the vegetation. Many plants appeared vegetatively but growing tip shriveled and turned brown before flowers bloomed; therefore, many of these plants were not identified. It is possible that the low rainfall for this early summer period reduced the number of species recorded for the prairie.

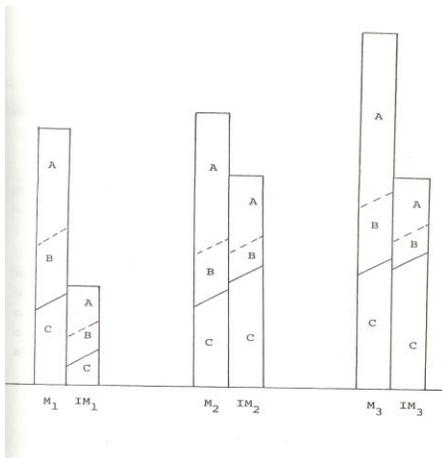


Figure 9 Comparison of soil depths and soil horizons for three mounds and corresponding intermound regions.

In both mound and intermound habitats the small forbs dried in May and June, leaving a vegetation consisting mainly of grasses. Although this phenomenon is common in prairies, it usually occurs later in the growing season and after plant reproductive cycles have been completed. This early desiccation of the prairie and its vegetation is reflected in the percent cover figures, which steadily decreased through June until cover was recorded as one percent in mid-June (Fig. 6). Generally, the intermound vegetation evidenced desiccation before that on the mounds. The low rainfall may have accentuated the difference recorded in mound and intermound vegetation cover, which will be discussed later. The rainfall is probably partially responsible for the low range of percent cover when these figures are compared to those of other studies (Drew, 1944; Whitman and Siggeirsson, 1954).

The method of plant collection rendered the information unsuitable for statistical analysis of the interaction between species occurrence and habitat (Table II). Upon inspection, there is no obvious distribution of certain families to either mounds or intermound regions. It is

noted that some genera within a family and some members of a genus were distributed, one in mound habitats, another in intermound habitats. The distribution, as recorded, reflects the interaction of the microhabitat conditions most favorable to each species. Determination of these conditions would require extensive research on the physiological growth requirements for each species. As mentioned above, some species never bloomed, due to drought; perhaps in a more pluvial year, when a greater number of representatives from each family bloomed, more conclusive remarks could be made about the distribution of plant families in the mound and intermound habitats.

Analysis of the difference in the percent cover data of mounds and intermounds revealed this difference to be statistically insignificant (Fig.6). Thus it is concluded that the variation of the percent cover was possible due to chance alone, and that the vegetation on mounds and intermounds is one plant population, not two. The inclined point quadrat method was used in this study with the basal contact modification, attempting to reduce the quantity of data and yet provide an accurate

assessment of the percent cover in the two habitats. Perhaps it would be possible to arrive at the conclusion that the two habitats support different populations, if the inclined point quadrat method were used without the basal modification. This would provide indirect information on the herbage production of the two habitats, in addition to the information collected with the basal contact modification. It was observed that the vegetation on the mounds was more luxuriant than in intermound areas (Fig. 2); perhaps this modification of the experiment as performed would accentuate the difference recorded into one significant both statistically and biologically.

Summarizing the soil analysis data, mounds and intermounds did not vary significantly in physical composition. Alternatively, it is possible that the soils varied chemically, but such determinations were not made. The soils of mounds and intermounds did vary in depth (Figs. 9 and 10). The difference noted in the percent cover on mounds and intermounds may possibly be attributed to the available water held in each soil. Perhaps the deeper mound soil provided for more extensive root growth, a cooler soil, and greater

soil area for storage of available water; in response, mound vegetation exhibited a somewhat higher percent cover and particular species composition. Conversely, the soil depth of intermounds allowed less root growth; provided a warmer soil and less soil space for water storage; thus intermound vegetation was lower in percent cover and contained species adapted to these conditions. If soil depth and its corresponding available water are influential in determining vegetation, it is possible that the difference noted in mound and intermound vegetation was greater this dry year than might normally be the case.

One difference between mounds and intermounds which may be significant is that most mounds were observed to contain the burrows of numerous animals; skunks, field mice and snakes were observed to inhabit mounds. The presence of these animals could influence the vegetation in numerous ways, by providing organic fertilizer to the mounds, changing the carbon dioxide levels of the mound soil, varying the compaction of the soil and displacing the root systems, especially tap roots. Depending on the extent of animal disturbance, the mounds could provide a habitat

which varied greatly from intermound habitats, a difference which could easily be mirrored by vegetation.

The observations and data support some of the general ideas offered in the introduction concerning pimple hills and refute others. The mound soil considered here was definitely not loess-like, but a sandy loam. The soil of mounds and intermounds was physically similar, and revealed similar horizons. There was no evidence to suggest that mounds were formed by animal activity, though animals were present on the study site. That the mounds studied occurred on upland ridges, were composed of sandy soil, and were aligned downslope, support the hypothesis that erosion creates and maintains mounds. Whether this erosion was enhanced by frost or desiccation fissures or tree pedestals were not determined. Trees do not now occur along the ridges considered; whether they once initiated mound formation might be elucidated by sectioning the mound to determine residual evidence of roots. Such sections, which would also have aided in estimating the extent of animal activity, were not made on the

insistence of the property owner.

Thus it may be said that the prairie considered exhibited a microrelief feature of pimple mounds and intermound regions, but the two soils did not vary in physical composition. These mounds were found to lie in an irregular pattern along an upland ridge with a slight alignment downslope. Mounds supported vegetation which differed in species composition from the vegetation of intermound regions; there was no significant difference in the percent cover by vegetation of these two prairie habitats, though the unassessed data suggested that the mounds were more productive than the intermound prairie. The abnormally low rainfall through the experimental period doubtlessly influenced the results of the vegetation study. Perhaps repetition of the vegetation study, with the modifications proposed herein, during a growing season with more normally distributed precipitation, would produce more reliable results, providing for more conclusive remarks about the vegetation of mounds and intermounds than can be extended here.

TABLE 1
LIST OF THE VASCULAR PLANTS COLLECTED FROM MARCH THROUGH
JULY, 1972, AT THE STUDY SITE LISTED BY FAMILIES
(Nomenclature according to U.T. Waterfall (1969);
common names according to Gleason (1963)
and Rechethin (1954)

<u>Scientific Name</u>	<u>Common Name</u>
Graminae	
<i>Andropogon Gerardi</i>	Big blue stem
<i>Andropogon scoparius</i>	Little blue stem
<i>Andropogon ternaries</i>	Splitbeard blue stem
<i>Bouteloua curtipendula</i>	Side-oats grama
<i>Bromus japonicus</i>	Japanese brome grass
<i>Cynodon Dactylon</i>	Bermuda grass
<i>Festuca octoflora</i>	Sixweeks fescue
<i>Hordeum pusillum</i>	Little barley
<i>Lolium multiflorum</i>	Italian rye grass
<i>Manisuris cylindrica</i>	Carolina jointtail
<i>Panicum oligosanthos</i> var. <i>Scribnerianum</i>	Scribners panicum
<i>Panicum Ravenelii</i>	--
<i>Panicum sphaerocarpon</i>	Roundseed panicum
<i>Panicum virgatum</i>	Switchgrass
<i>Sorghastrum nutans</i>	Indian grass
<i>Sporobolus cryptandrus</i>	Sand dropseed
Cyperaceae	
<i>Carex caroliniana</i>	Carolina sedge
<i>Cyperus filiculmis</i>	Slenderleaf sedge
Liliaceae	
<i>Camassia scilloides</i>	Wild hyacinth, Atlantic camas
<i>Erythronium albidum</i>	Dogtooth violet, white fawn lily
<i>Nothoscordum bivalve</i>	Yellow false-garlic
Amaryllidaceae	
<i>Hypoxis hirsute</i>	Stargrass, common goldstar
Orchidaceae	
<i>Spiranthes vernalis</i>	Upland ladies tresses
Santalaceae	
<i>Commandra Richardsoniana</i>	Bastard toad-flax
Polygonaceae	
<i>Eriogonum longifolium</i>	Longleaf wild-buckwheat
Portulacaceae	
<i>Claytonia virginica</i>	Spring beauty
Caryophyllaceae	
<i>Arenaria patula</i>	Pitchers sand wort
<i>Cerastium vulgatum</i> var. <i>vulgatum</i>	Mouse-ear chickweed, Big chickweed

Ranunculaceae	
<i>Anemone virginiana</i>	Virginia anemone, wind- flower
<i>Delphinium tricornis</i> forma <i>albiflora</i>	Rock larkspur
<i>Ranunculus hispidus</i>	Bristly buttercup
Cruciferae	
<i>Selenia aurea</i>	Yellow selenia
Saxifragaceae	
<i>Saxifraga texana</i>	Texas saxifrage
Leguminosae	
<i>Dalea purpurea</i>	--
<i>Lotus americanus</i>	Deervetch
<i>Schrankia uncinata</i>	Catclaw sensitive briar
<i>Tephrosia virginiana</i> var. <i>holosericea</i>	Goats rue, Virginia tephrosia
Oxalidaceae	
<i>Oxalis corniculata</i>	Wood sorrel, creeping oxalis
<i>Oxalis dillenii</i>	Sheep sorrel, wood sorrel
Polygalaceae	
<i>Polygala incarnate</i>	Pink milkwort
<i>Polygala sanguinea</i>	Blood milkwort
Umbelliferae	
<i>Eryngium yuccafolium</i> var. <i>synchaetum</i>	Yucca-leafed eryngo
<i>Polytaenia Nuttallii</i> var. <i>Nuttallii</i>	Prairie parsley
Gentianaceae	
<i>Sabatia campestris</i> forma <i>campestris</i>	Prairie rosegentian
Asclepiadaceae	
<i>Asclepias stenophylla</i>	Slimleaf milkweed
<i>Asclepias veridis</i>	Milkweed
Hydrophyllaceae	
<i>Phacelia strictiflora</i>	Prairie phacelia
Labiatae	
<i>Scutellaria parvula</i> var. <i>Leonardi</i>	small skullcap
Solanaceae	
<i>Solanum carolinense</i> forma <i>carolinense</i>	Carolina horse nettle
Scrophulariaceae	
<i>Buchnera Americana</i>	American blueheart
<i>Castilleja coccinea</i> var. <i>coccinea</i>	Painted cup, Indian paintbrush
<i>Linaria canadensis</i> var. <i>texana</i>	Old-field toadflax
<i>Penstemon tubaeiflorus</i>	Beard tongue, tube penstemon

Acanthaceae

Ruellia humilis

Low ruellia

Plantaginaceae

Plantago aristata

Bottlebrush plantain

Plantago elongate

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Plantago media

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Plantago Purshii var. *Purshii*

Wooly plantain

Plantago virginica

Paleseed plantain

Rubiaceae

Hedyotis crassifolia

Tiny bluet

Valerianaceae

Valerianella Nuttallii

Nuttall cornsalad

Campanulaceae

Lobelia spicata var.*leptostachys*

Palespike lobelia

*Specularia perfoliata*Clasping Venus'
lookingglass

Compositae

Achillea lanulosa

Western yarrow

Antennaria neglecta

Everlasting, pussytoes

Aster ericoides

Wild aster, heath aster

*Coreopsis grandiflora*Tickseed, big-flower
coreopsis*Echinacea pallida*

Coneflower, pale echinaceae

*Erigeron strigosus*Daisy fleabane,
prairie fleabane*Erigeron tenuis*

Slender fleabane

*Gnaphalium purpureum*Cudweed, everlasting,
purple cudweed*Hieracium longipilum*

Longbeard hawkweed

Krigia dandelion

Tuber dwarf dandelion

*Liatris pycnostachya*Blazing star, Kansas
gayfeather*Rudbeckia hirta*

Coneflower, blackeyed susan

Solidago mollis

Ashy goldenrod

TABLE II
PLANTS COLLECTED, NOTING WHETHER THE SPECIES OCCURRED
ON MOUNDS, IN INTERMOUND REGIONS, OR BOTH
(ASTERISK DESIGNATES IN WHICH HABITAT A SPECIES FIRST BLOOMED)

Mound Species

<i>Achillea lanulosa</i> forma <i>lanulosa</i>	<i>Panicum Ravenelii</i>
<i>Bromus japonicus</i>	<i>Panicum virgatum</i>
<i>Cerastium vulgatum</i> var. <i>vulgatum</i>	<i>Phacelia strictiflora</i>
<i>Claytonia virginica</i>	<i>Plantago aristata</i>
<i>Delphinium tricornae</i> forma <i>albivlora</i>	<i>Plantago elongata</i>
<i>Echinacea pallida</i>	<i>Plantago Purshii</i> var. <i>Purshii</i>
<i>Erigeron strigosus</i>	<i>Rudbeckia hirta</i>
<i>Eriogonum longifolium</i>	<i>Solanum carolinense</i> forma <i>carolinense</i>
<i>Hieracium longipilum</i>	<i>Solidago mollis</i>
<i>Lolium multiflorum</i>	<i>Specularia perfoliata</i>
<i>Manisuris cylindrical</i>	<i>Tephrosia virginiana</i> var. <i>holosericea</i>
<i>Oxalis dillenii</i>	<i>Valerianella Nuttallii</i>
<i>Panicum oligosanthos</i> var. <i>Scribnerianum</i>	

Intermound Species

<i>Antennaria neglecta</i>	<i>Lotus americanus</i>
<i>Arenaria patula</i>	<i>Nothoscortum bivalve</i>
<i>Asclepias stenophylla</i>	<i>Oxalis corniculata</i>
<i>Bouteloua curtipendula</i>	<i>Panicum sphaerocarpon</i>
<i>Bucchnera Americana</i>	<i>Penstemon tubaeiflorus</i>
<i>Camassia scilloides</i>	<i>Plantago media</i>
<i>Castilleja coccinea</i> forma <i>coccinea</i>	<i>Plantago virginica</i>
<i>Dalea purpurea</i>	<i>Polygala incarnate</i>
<i>Erigeron tenuis</i>	<i>Polygala sanguinea</i>
<i>Eryngium yuccafolium</i> var. <i>synchaetum</i>	<i>Polytaenia Nuttallii</i> var. <i>Nuttallii</i>
<i>Erythronium albidum</i> var. <i>albidum</i>	<i>Saxifraga texana</i>
<i>Hordeum pusillum</i>	<i>Scutellaria parvula</i> var. <i>Leonardi</i>
<i>Hypoxis hirsute</i>	<i>Selenia aurea</i>
<i>Krigia dandelion</i>	<i>Spiranthes vernalis</i>
<i>Liatris pycnostachya</i>	

Mound and Intermound Species

<i>Andropogon Gerardi</i>	<i>Gnaphalium purpureum</i>
<i>Andropogon scoparius</i>	<i>Hedyotis crassifolia</i>
<i>Andropogon ternaries</i>	<i>Linaria canadensis</i> var. <i>texana</i> *IM
<i>Anemone virginiana</i> *M	<i>Lobelia spicata</i> var. <i>leptostachys</i>
<i>Asclepias viridis</i>	<i>Ranunculus hispidus</i>
<i>Aster ericoides</i> *IM	<i>Ruellia humilis</i>
<i>Carex caroliniana</i>	<i>Sabatia campestris</i> forma <i>campestris</i>
<i>Comandra Richardsoniana</i>	<i>Schrankia uncinata</i>
<i>Coreopsis grandiflora</i>	<i>Sorghastrum nutans</i>
<i>Cynodon dactylon</i>	<i>Sporobollus cryptandrus</i>
<i>Cyperus filiculmis</i>	
<i>Festuca octoflora</i> *IM	

TABLE III
COMPARISON OF THE PHYSICAL COMPOSITION OF THE SOIL
FROM MOUND AND INTERMOUND REGIONS, DETERMINED BY THE BOUYOCOS METHOD
(MOUNDS AND INTERMOUNDS ARE DESIGNATED BY Numbers 1,2,3.
Soil horizons are noted as A, B, C)

MOUND	Average		Average		Average	
	% Sand	% Sand	% Silt	% Silt	% Clay	% Clay
1A	85.2		10.7		4.1	
2A	78.4	80.5	14.8	13.7	6.8	5.8
3A	77.9		15.6		6.5	
1B	85.7		9.4		4.9	
2B	79.4	83.4	9.7	8.9	10.9	7.7
3B	85.2		7.6		7.2	
1C	79.0		11.3		9.7	
2C	71.4	71.5	11.6	11.4	17.0	17.1
3C	64.2		11.3		24.5	

INTERMOUND	Average		Average		Average	
	% Sand	% Sand	% Silt	% Silt	% Clay	% Clay
1A	79.6		11.5		8.9	
2A	78.4	77.9	15.3	14.9	6.3	7.2
3A	75.7		17.9		6.4	
1B	82.0		12.5		5.5	
2B	71.6	75.3	15.4	15.9	13.0	8.8
3B	72.2		19.7		8.1	
1C	81.8		11.3		6.9	
2C	50.8	58.5	13.9	14.3	35.5	27.2
3C	42.8		17.8		39.4	

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