

Remnant Prairies on the Shallow Limy Range Site in North Central Kansas¹

G. K. HULETT AND G. W. TOMANEK

*Associate Professor of Botany and
Professor of Biology, Fort Hays Kansas
State College, Hays.*

Highlight

Eleven ungrazed shallow limy range sites were studied as to species composition, edaphic characteristics, and range condition. These stands were located in the shale-limestone region of north-central Kansas. The sites were dominated by little bluestem and big bluestem. Edaphic conditions were marked by high surface rockiness, basic pH, low mulch, and low water-retaining capacity. Range condition as assessed by the Dyksterhuis method placed all stands in excellent range condition.

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Intelligent management practices must be based on sound knowledge of range sites within the management area. An understanding of soil, plant, and climatic interrelationships is essential to proper range condition evaluation and thus to proper stocking and utilization.

One of the major sources of knowledge of such relationships is available in remnant grasslands that have not been subjected to the pressures of livestock grazing. Such areas represent a point of departure for management practices (Dyksterhuis, 1949) and tend to provide rationale for many concepts in range management. Mason et al. (1967) demonstrated this point for a relict grassland in Utah and referred to other studies of a similar nature in Utah and elsewhere. Remnant grasslands have also been investigated in North Dakota (Hanson and Whitman, 1938) and Wisconsin (Curtis 1955; Dix 1959).

In Kansas, few studies of remnant grasslands have been made. Tomanek and Albertson (1957) reported on ungrazed prairies in two locations in

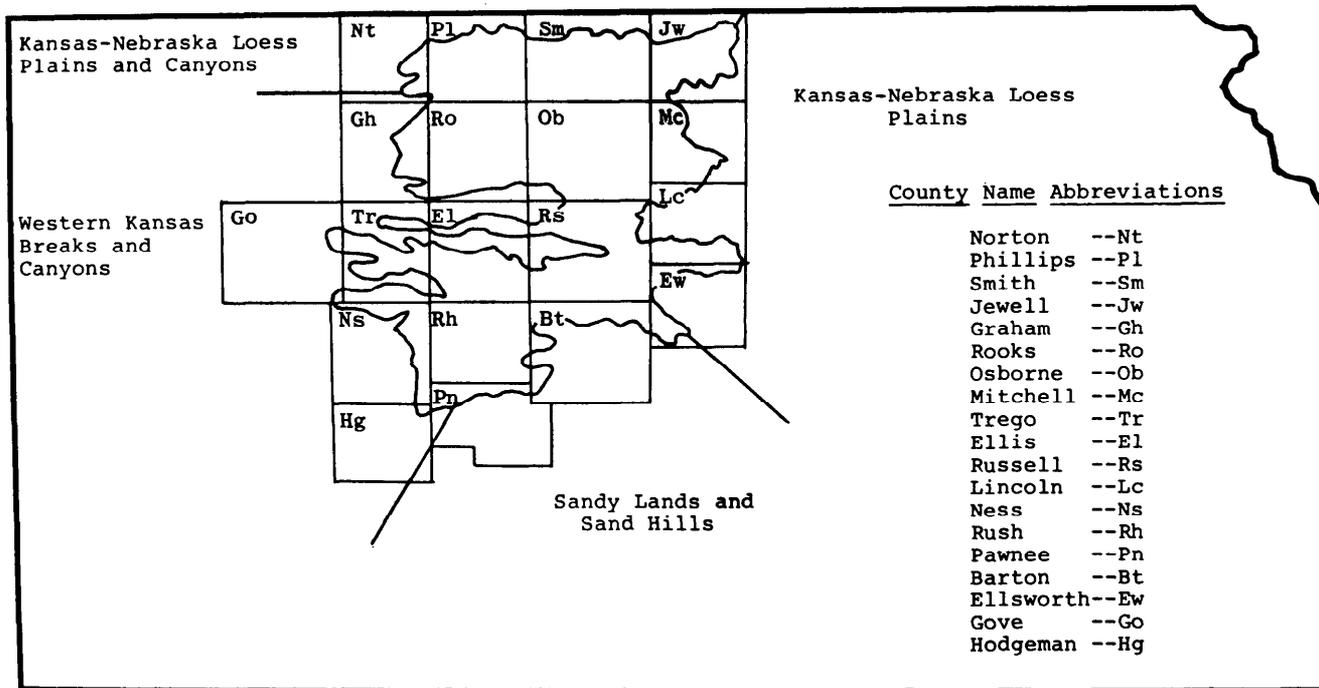


FIG. 1. Location of shale-limestone parent material region in Kansas. Adjacent resource regions are also given.

Western Kansas and Linnell (1961) studied soil-vegetation relationships on chalkflat range sites in the same region. Ankle (1963) investigated an ungrazed breaks range site in the shale-limestone area of Kansas.

The present project was initiated to secure quantitative data on vegetation and soils of remnant shallow limy range sites in the shale-limestone region of North Central Kansas. The shallow limy range site includes what was formerly termed the breaks range site. Therefore, the technical description as used by the U.S. Soil Conservation Service for breaks range sites is used in describing the shallow limy site. According to the SCS, this site occurs mainly on nearly level to steeply rolling lands with slopes averaging 12 to 15%. The soil depth is characteristically less than 20 inches and the soils are poorly developed A-C soils. A specific site location is found in part of the Fort Hays Kansas State College pasture (S $\frac{1}{2}$ -36, T3S, R 19W).

The documentation of remnant prairies representing such sites is essential since they are rapidly disappearing as man finds new ways to utilize these previously ungrazed areas. Also, the structural aspects described in this project will provide information needed for further investigations on the functional nature of grassland communities and a more complete understanding of the grassland ecosystem.

Study Area and Procedure

The stands selected for study are located within the confines of the shale-limestone section of the Central Kansas Rolling Plains Region (Fig. 1). This area of the

Mixed Prairie includes nearly 5,000,000 acres (Fly, 1946), extending from near the Nebraska line south to the Arkansas Valley.

The climate of the area is classified as semiarid and is typically continental with large fluctuations in temperature. Rainfall averages from 21 to 25 inches annually from west to east across the study area. Long-time records show extremes of 43.34 inches in 1951 to 9.21 inches in 1956 for the wettest and the driest year, respectively. The average annual temperature ranges from 53 to 55 F from north to south.

During 1965 and 1966, eleven remnant shallow limy stands located upon shale-limestone derived soils were selected. These stands were ungrazed by domestic stock and had not been subjected to regular mowing or burning. Within each of the stands the vegetation was sampled by 100 systematically-placed point frames to measure percentage composition and basal cover. Forty rectangular 0.25 m² quadrats were also examined in each stand in sampling the vegetation. Absolute frequency and percentage presence were calculated from these data.

Topographical characteristics, including exposure, slope, and position on slope were recorded on each stand. In addition, subjective ratings on a scale from 1 to 5 (1 = low and 5 = high) were made on mulch, dusting susceptibility, and rodent disturbance.

Five soil samples were collected from each stand at a depth of 0 to 6 inches and were pooled into a composite sample. Soil texture was determined by the hydrometer method. Percentage rock was obtained by sieving the soil samples through a 2-mm sieve and separating rocks larger than 2 mm. The rock content was then expressed as a percentage of the weight of the soil sample. Wilting point at 15 atm was determined, using a pressure membrane apparatus, while water-retaining capacity was determined with Hilgard cups.

Table 1. Mean percentage composition and basal cover of major grass species on eleven remnant shallow limy stands in Western Kansas.

Species	Composition (%)		Basal Cover (%)	
	Mean	Range	Mean	Range
Little bluestem				
<i>Andropogon scoparius</i>	34.56	(0-70.56)	4.04	(0-11.4)
Big bluestem				
<i>Andropogon gerardi</i>	25.70	(0-65.63)	2.40	(0-4.9)
Side-oats grama				
<i>Bouteloua curtipendula</i>	21.29	(8.82-39.72)	1.90	(.6-2.8)
Plains muhley				
<i>Muhlenbergia cuspidata</i>	1.11	(0-7.77)	0.16	(0-1.5)
Hairy grama				
<i>Bouteloua hirsuta</i>	4.42	(0-14.46)	0.45	(0-1.5)
Blue grama				
<i>Bouteloua gracilis</i>	5.57	(0-18.07)	0.55	(0-2.2)
Hairy dropseed				
<i>Sporobolus pilosus</i>	0.93	(0-4.7)	0.10	(0-.7)
Switch grass				
<i>Panicum virgatum</i>	0.05	(0-.55)	0.01	(0-.1)
Red Three-awn				
<i>Aristida longiseta</i>	0.27	(0-41.19)	0.02	(0-2.8)
Sand dropseed				
<i>Sporobolus cryptandrus</i>	0.13	(0-1.47)	0.01	(0-.1)
Tall dropseed				
<i>Sporobolus asper</i>	0.13	(0-1.47)	0.01	(0-.1)
Others	5.84		0.59	
Totals	100.00		10.24	

Percentage organic matter, available phosphorus, available potassium, and pH were determined at the Kansas State University Soil Testing Laboratory.

Results

The grass vegetation on the remnant stands was dominated by little bluestem² and big bluestem (Table 1). These species plus side-oats grama account for over 80% of the vegetation. Although these three species were dominants when the 11 stands were considered in composite, there was considerable variability in the composition of the individual stands. One stand did not have any little bluestem recorded in the point or quadrat sampling, however, it was present in the stand.

Two shortgrasses, blue grama and hairy grama were the other major associated species found on the shallow limy habitat. However, the importance of blue grama on this site is much less than on heavier textured clay-upland range sites (Albertson and Tomanek, 1965). The low importance of the shortgrasses was accompanied by a relatively low basal cover, a typical situation on the immature A-C soils of shallow limy range sites.

In addition to the dominant grasses on the shallow limy stands, there were many associated forbs

Table 2. Percentage absolute frequency, relative frequency, and presence of 25 forbs on eleven remnant shallow limy stands in Western Kansas.

Species	Ab. Freq.	Rel. Freq.	Presence
Western ragweed			
<i>Ambrosia psilostachya</i>	20.0	02.99	81.8
Black samson			
<i>Echinacea angustifolia</i>	37.2	05.58	90.9
Green thread			
<i>Thelesperma gracile</i>	16.3	02.45	90.9
Broom snakeweed			
<i>Gutierrezia sarothrae</i>	13.8	02.07	54.5
Blazing star			
<i>Liatris punctata</i>	12.5	01.87	81.8
Oblong-leaved aster			
<i>Aster oblongifolius</i>	07.7	01.15	54.5
Narrow-leaved tetraeneuris			
<i>Tetraeneuris stenophylla</i>	09.7	01.46	54.5
Purple-prairie clover			
<i>Petalostemon purpurea</i>	07.5	01.12	81.1
Resinous skullcap			
<i>Scutellaria resinosa</i>	38.4	05.76	90.9
Wavy-leaved thistle			
<i>Cirsium undulatum</i>	06.1	00.92	63.6
Annual sunflower			
<i>Helianthus annuus</i>	10.6	01.60	54.5
James' whitlowwort			
<i>Paronychia jamesii</i>	17.5	02.62	72.7
White-prairie clover			
<i>Petalostemon candidum</i>	02.7	00.40	36.4
Serrate-leaved evening primrose			
<i>Oenothera serrulata</i>	18.2	02.72	72.7
Many-flowered aster			
<i>Aster ericodes</i>	12.7	01.90	72.2
Rigid-leaved goldenrod			
<i>Solidago rigida</i>	07.5	00.12	45.5
Few-flowered scurfpea			
<i>Psoralea tenuiflora</i>	11.4	01.70	54.5
Narrow-leaf houstonia			
<i>Houstonia angustifolia</i>	22.3	00.34	81.8
Cat claw sensitive briar			
<i>Shrankia uncinata</i>	13.6	02.02	72.7
Lead plant			
<i>Amorpha canescens</i>	03.8	00.57	36.4
Stinging spurge			
<i>Tragia ramosa</i>	27.7	04.15	54.5
Heath aster			
<i>Aster arenosus</i>	09.5	01.43	54.5
Narrow-leaved puccoon			
<i>Lithospermum linearifolium</i>	03.6	00.54	81.8
Indian breadroot			
<i>Psoralea esculenta</i>	01.8	00.27	45.5
Toothed euphorbia			
<i>Euphorbia dentata</i>	03.9	00.57	45.5

(Table 2). The mean number of species per stand was 60 with a range from 43 to 75. Many forbs were present on most of the stands, but did not have a high frequency within the stand; they were resinous skullcap, narrow leaf houstonia, narrow

²See Tables 1 and 2 for scientific names of grasses and forbs.

Table 3. Mean and range of environmental characteristics for eleven remnant shallow limy stands in the shale-limestone parent material region of Western Kansas.

Characteristic	Mean	Range
Wilting point (%)	14.00	9.05-19.72
Water-retaining capacity (%)	68.61	55.66-82.98
Rock (%)	33.84	11.93-66.33
Sand (%)	29.19	17.90-44.00
Silt (%)	48.55	38.50-72.30
Clay (%)	22.25	9.80-36.70
Slope (degrees)	16.56	3.2 -28
Organic Matter (%)	3.39	2.5 - 4.2
Available P (ppm)	1.5	0-5
Available K (ppm)	193	104-303
Depth to lime (inches)	< 1 ¹	0
pH	8.0 ¹	0
Mulch	1 ¹	1-3
Dusting Possibility	4 ¹	4-5
Rodent Disturbance	5 ¹	4-5

¹ These figures represent modal values.

leaf puccoon, blazing star, blacksamson and slender greenthread. These forbs characterize ungrazed shallow limy stands floristically.

Some environmental characteristics in the 11 stands were uniform while others showed considerable variability (Table 3). The three most distinguishing features of the shallow limy range site are related to the limestone out-crops upon which this site usually occurs. The percentage of rock was high in most of the stands. A minimum of 11.93% was recorded, which is much higher than on other range sites; e.g., clay uplands. The rocky nature of the stands is also indicated by the effervescence reaction to hydrochloric acid at the surface on all 11 stands. Associated with the surface rockiness was a moderately high and consistent pH.

Moisture relationships on the shallow limy stands are perhaps the most influential factor affecting the vegetation. The water-retaining capacity and wilting point reflect the low amount of organic matter and clay particles in the soil surface. These two features coupled with the low mulch cover should result in the sites being xeric. Augmenting this tendency towards a xeric environment are the relatively steep slopes upon which most shallow limy stands are situated. The shallow limy stands are usually located near the crest of the slope thus resulting in an unfavorable moisture runoff-accumulation ratio for the site. All these features imply that this range site is a dry and unfavorable habitat for bluestem grasses. However, there is another factor of the habitat that was not measured in this project that should be considered. The presence of limestone fragments on the soil surface and the highly fissured parent materials result

in increased infiltration of precipitation into the soil (Albertson, 1937). The result is a mesophytic environment that is not in phase with the surface organic matter and clay content levels. Albertson (1937) also reported extensive rooting of plants in fissures on limestone outcrops and speculated on the competitive effects of such differential rooting.

Shallow limy range sites are generally not subjected to rodent disturbances. Rodent activity was low on all stands, since the textural qualities of the soils are not conducive to the burrowing animals such as the plains pocket gopher (*Geomys bursarius*).

There was little evidence of dusting (deposition of wind blown material from adjacent cultivated land) on the remnant stands, which is expected since most of the immediate surrounding terrain is in pasture rather than cultivation. It is doubtful that dusting is of any ecological significance in determining the specific composition of the stands investigated.

Range Condition of the Stands

There has been interest recently (Tomanek, 1967) in establishing a flexible system of range condition evaluation. The Dyksterhuis (1949) method is widely used and in all but a few areas (Coupland et al., 1960) seems to work well in defining correct stocking rates. When the range condition of the 11 breaks stands was calculated (according to the Dyksterhuis method) it was found that they all were in excellent condition. However, there was considerable variation in the range condition values. The lowest condition was 77%, which occurred on a stand dominated by big bluestem and side-oats grama. Of the remaining 10 stands, two had range condition evaluations between 80 and 90%. The last group was dominated by the two bluestems. The average range condition of the stands was 91%.

The conclusion is that the Dyksterhuis method did satisfactorily place all 11 stands in excellent range condition, which is the expected since these stands were ungrazed and should represent the climax condition. There was also no evidence of the range condition decreasing with non-use, a phenomenon that is suspected to occur on clay-upland range that is ungrazed or used very lightly. On clay-upland range sites near Hays, Kansas, which have been protected for nearly 35 years, it has been observed that the range condition degenerates into a weedy state.

Conclusions

Grass vegetation on the stands was dominated by little bluestem, big bluestem, and side-oats grama. Blue grama and hairy grama were the major associated species.

Forb populations on the sites were floristically diverse. Characteristic or indicator forbs included resinous skullcap, black samson, and narrow leaf puccoon.

Edaphic conditions were marked by high surface rockiness, basic pH, low mulch, and low water-retaining capacity. Mesophytic conditions probably result from increased infiltration rates due to fragmented and fissured parent material.

Range condition as assessed by the Dyksterhuis method placed all stands in excellent range condition, even though considerable variability existed in the specific composition of the stands.

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