Heavy Precipitation Influences Saline Clay Flat Vegetation[1,2]

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Highlight

A vegetational analysis was made of the native grasses on a saline clay flat range site located on the Rio Grande Plains of Texas prior to and two months following Hurricane Beulah in 1967. Data prior to the hurricane indicated a mean grass plant density of about 26,000 per acre with negligible yield. Following the hurricane, an influx of annual and short-lived perennial grasses increased the density to approximately 700,000 grass plants per acre. Herbage yields increased to over 1200 pounds per acre. Presence of short-lived grasses provided forage and a desirable microenvironment for the establishment of seedlings of the more desirable grasses.

The Rio Grande Plains are commonly known as the "brush country of South Texas." This vast expanse (17,000,000 acres) of grazing land has been almost completely invaded by brush species and cacti since settlement (Johnston, 1963). Brush invasion has greatly reduced grazing capacity and has increased the difficulty of working livestock.

Potential productivity varies widely in the Rio Grande Plains. In this region, the saline clay flat site is low in productivity. It is difficult to predict the potential on sites of this type due to the complexity of edaphic and climatic influences on vegetation (Fanning et al., 1965).

A fortuitous combination of events presented the opportunity to study the effect of higher than average precipitation on the ecology of a saline clay site in 1967. A vegetation study that involved detailed analysis of the composition, density, and herbage yield had been completed in August, 1967, just prior to the advent of Hurricane Beulah. The same type of analysis was repeated two months following the hurricane, during which more than 13 inches of precipitation was received.

Study Area and Methods

The study area was located on the Rio Grande Plains of South Texas approximately 18 miles NNE of Zapata in Zapata County, Texas. A nearly homogeneous vegetative cover of native grass species form the vegetation of the area. It was rootplowed, raked and stacked in 1962.

The area is a saline clay flat range site on a Montell clay soil type. Montell is a Montmorillonitic clay having an AC horizon with high shrink-swell properties. All horizons of the Montell series have been described as strongly calcareous and possessing blocky structure. The A horizon has an exchangeable sodium concentration above 25% and the AC horizon in excess of 30% (Fanning et al., 1965).

Typical of the Great Plains of North America, the precipitation in Zapata County is erratic. Laredo, 35 air miles from the study area, has a 26-year average annual precipitation of 20.47 inches; ranging from a low of 9.61 inches in 1955 to a high of 23.81 inches in 1967 (Table 1). Precipitation of 26.39 inches was recorded at the study area in 1967. The greatest monthly precipitation usually occurs in May and September, and the least from December to April. The average annual temperature is 74.6 F with midday temperatures in excess of 100 F from June to September and nighttime lows below freezing from December to February. Evaporation normally exceeds precipitation every month of the year. However, in 1967 precipitation exceeded evaporation in September and November.

Vegetational history of the area, although sketchy, indicates this was primarily a grassland composed of moderately to highly salt tolerant species prior to development of artificial water sources and the advent of heavy grazing. Along with heavy grazing and the removal of the more desirable herbaceous species came the encroachment of spiny woody species and an increase in less desirable grass species (Smith, 1899). Old records and scattered remnants indicate that the climax vegetation included alkali sacaton (*Sporobolus airoides*) twoflower trichloris (*Trichloris crinita*), Arizona cottontop (*Trichachne californica*) and several of the tridens (*Tridens* spp.). Woody species were probably located only along the arroyos and in scattered mottes. The current woody species include, in descending order of density, pricklypear (*Opuntia* spp.), saladillo (*Varilla texana*), mesquite (*Prosopis juliflora*) and retama (*Parkinsonia aculeata*). The two important grasses are curlymesquite (*Hilaria belangeri*), and whorled dropseed (*Sporobolus pyramidatus*).

The study area was fenced to prevent domestic livestock grazing in July, 1966. Prior to this, it had been part of a cattle ranching operation. The vegetation was initially sampled in mid-August 1967. Three months later, 60 days following the heavy precipitation of Hurricane Beulah, the plots were again sampled. Measurements taken on both dates included species composition and density. Due to drought condition herbage production was not measurable in August. However, it was obtained in November.

One hundred, 2-acre plots were systematically established on this area. Nineteen of these were randomly selected for study. Each plot was sampled at 20 randomly spaced points along a diagonal transect. These provided 30 or more measures on the dominant species as recommended by Dix (1961) for the point-center quarter method.

The sampling technique used in this study was a modification of the point-centered quarter method (Dix, 1961). This method has the advantage of being quantitative and can be objective if the sampling units are selected at random. Three measurements normally used in characterizing a grassland were obtained with this sampling method. In addition to density and species composition, the nearest plant in each quarter was clipped for yield determinations. As indicated by Penfound (1963) weight may be a valuable

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Table 1. Temperature (°F) and evaporation (inches) for 1967 and 26 year average precipitation (inches) at Laredo, Texas and 1967 precipitation at the study area.

	LAREDO					
	Temperature					Study Area
Month	High	Low	Avg	Evap	26 yr. avg. Precipitation	Ppt
Jan	85	29	58.5	3.34	1.14	0.94
Feb	86	30	61.4	3.96	0.88	0.27
Mar	96	43	74.0	7.02	0.84	0.61
Apr	101	63	82.7	9.08	1.14	3.10
May	103	58	83.7	10.50	3.64	0.06
June	104	67	87.1	12.38	1.77	0.87
July	105	68	87.9	13.65	1.60	0.55
Aug	104	67	84.8	9.42	1.46	2.62
Sept	96	52	78.9	5.07	3.35	13.26
Oct	89	44	73.1	4.71	2.04	0.46
Nov	89	40	66.3	2.19	1.25	3.08
Dec	79	31	57.3	2.25	1.36	0.57
Total				83.57	20.47	26.39

Table 2. Grass composition (%) by density and yield, and total density and yield for August and November 1967 on saline clay flat range site.

	Composition by density		Composition by yield	
Species	Aug.	Nov.	Aug.	Nov.
Curlymesquite	69.7	24.7	t[1]	20.0
Whorled dropseed	7.4	13.1	t	10.4
Red grama	7.6	2.4	t	1.7
Bristlegrass	3.1	1.7	t	3.6
Panicum spp.	0	51.0	t	56.2
Green sprangletop	0	6.2	t	4.7
Prairie cupgrass	0	0.3	t	0.2
Sandbur	0	0.5	t	1.4
Buffelgrass	0	0.1	t	2.9
Unidentified species	9.3	0	t	—
Total density and yield	26,000[2]	700,000[2]		1210[3]

[1] Denotes presence, but insufficient quantity to collect.
[2] Grass plants/acre.
[3] Pounds/acre, ovendry.

parameter in measuring dominance. Clipped plants were composited by species, oven dried, and weighed. Yield by species was the average dry weight per plant times the species density. Total production per acre was the sum of the species yield.

A plant was considered to be a visually discernable unit including rooted stems and foliage but excluding stolons. Distance measurements were from the center point to the nearest living plant tissue at ground level. Grasses were the only plants measured.

Results

Climatic conditions at the study site were about average for the year preceding Hurricane Beulah except for below normal precipitation. From August 1966 to August 1967 the precipitation at Zapata was 10.25 inches. However, in the next three months 19.39 inches were received with 13.26 inches occurring in September, primarily as a result of the hurricane.

FIG. 1. Saline Clay Flat range site depicting sparsity of cover in August, 1967, prior to Hurricane Beulah.

Average plant density in August 1967 was 26,237 grass plants per acre, ranging from 2505 to 66,000 (Fig. 1). Only four grass species were identified: Curlymesquite, red grama (*Bouteloua trifida*), whorled dropseed, and plains bristlegrass (*Setaria macrostachya*). Curlymesquite, a mat forming shortgrass, was the dominant species and made up 69.7% of the composition ranging from 41.3 to 96.3%. Due to the dessicated state of the vegetation 10% of the composition was composed of unidentified grass species. Species of tridens, green sprangletop (*Leptochloa dubia*), prairie cupgrass (*Eriochloa contracta*), and Hall's panic (*Panicum hallii*) occurred on the area, but were not sampled.

Herbage production was not measurable in August (Table 2). Rarely did any grass exceed 2 inches in height or 1 inch in basal diameter. The herbage was so dry that when clipped shattering was common. In November, at maturity of most grasses, a drastic change had occurred in density, production, and composition of the herbaceous vegetation (Fig. 2).

Plant densities in November had increased over 22 fold and ranged from about 400,000 to 1,000,000 plants per acre. Species composition had also undergone major change (Table 2). Curlymesquite contributed only 24.7%, while *Panicum* spp. and green sprangletop, absent in the August sample, contributed substantially to the total composition.

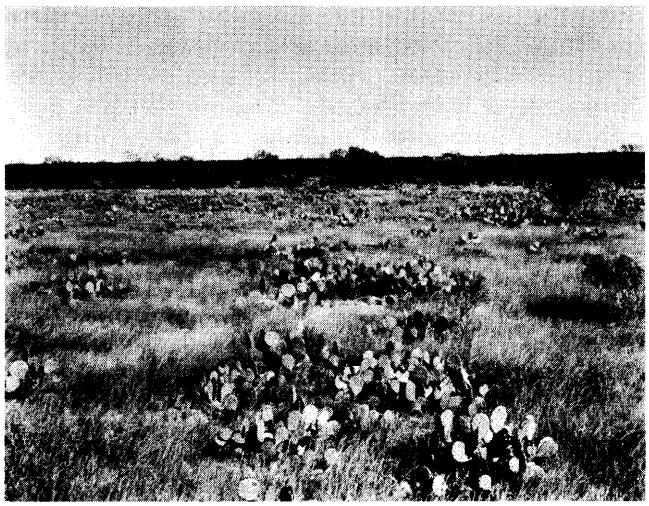

FIG. 2. Saline Clay Flat range site November, 1967, two months following Hurricane Beulah.

Mean production was approximately 1200 pounds/acre ranging from 731.7 to 1743.7 pounds/acre between plots. Production on most plots grouped quite closely around the mean.

Discussion

Two facts stand out in this study: (1) a large increase in grass production and (2) considerable change in composition and density. These changes occurred in a relatively short time in the fall following excessive precipitation. The saline soils of the Rio Grande Plains are considered to be droughty due to high salt content, low rainfall, and high evaporation. Fanning et al. (1965) point out that the high salt concentration, particularly with increasing depth, limits not only the species present but also herbage production. Some species can tolerate salt concentration in the surface soil but few will root into the subsoil. They also report salt concentrations of 7.0, 16.2, and over 20.0 mmhos/cm at depths of 0–9, 9–17, and 17–48 inches, respectively in the Montell clays. The United States Salinity Laboratory (1954) reports that salt concentrations greater than 4.0 mmhos/cm limits production of most forage crops, above 8.0 permits growth of only moderately salt tolerant species, and above 12.0 mmhos/cm allows only the most salt tolerant species to survive.

Data in Table 2 indicate that with adequate rainfall a lush growth of mostly ephemeral grasses occurred in the saline clay flat sites of the Rio Grande Plains. Plant density increased from about 26,000 to approximately 700,000 plants per acre in the 60-day period following heavy precipitation. This increase indicated rapid germination and growth of these species. Composition change was illustrated by the high percentage of panic grasses (*Panicum* spp.) following the fall rains. Also indicated was the rapid recovery and potential cover provided by short-lived perennial and annual grass species. Most species of *Panicum* that occurred were members of the subgenerus Eupanicum. They have been described by Hitchcock and Chase (1951) as perennials exhibiting ephemeral characteristics of extremely short life cycle and a relatively shallow root system. Characteristically, such grasses show an immediate response to precipitation (Weaver and Clements, 1938). Although this type of plant is not highly desirable it does furnish a desirable environment for seedling establishment and limited short-term production.

Percentage of composition contributed by the dominants, based on density, was comparable to that based on herbage yield (Table 2). Curlymesquite, a sod forming grass, and a bunch grass, whorled dropseed, were represented in the dominants. Apparent differences were also noted in composition of the minor species. The density-weight relationships exhibited by the dominants may indicate the usefulness of density in predicting yield of native perennial grass species. Based on plant density in August, curlymesquite, whorled dropseed and red grama were the dominants, indicating that production during dry periods could be related to the occurrence of these species rather than the dominant species indicated by the November data.

Curlymesquite is the major species in this soil type due to persistence during dry periods. It does not appear to make the rapid growth of other species, but its herbage remains available longer. This is indicated by the high percentage of the composition contributed in August following an unusually long uninterrupted drought.

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