

DROUGHT AND GRAZING MANAGEMENT DECISIONS

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Drought is unique among spells of weather; it creeps upon us gradually, almost mysteriously, but its consequences are a terrible reality. In many instances the damaging effects of drought on the vegetation are not fully realized until it is over. The semiarid and arid lands which make up the greater part of the grazing areas of the world are subjected to protracted periods of deficient precipitation and hence decreased production of forage. It is a common practice for grazing lands to be fully stocked on the basis of the average or better season before a drought. Consequently, if grazing is not immediately reduced in proportion to the decline in forage production, there will be heavy overgrazing with subsequent injury to the forage species. The deterioration of many grazing lands began during protracted drought periods. There generally is no problem in managing the range resource during the wetter years. The years of less than average precipitation set the pattern of land use, and must be anticipated and planned for safe utilization of the range.

From 1951 through 1956, the southwestern United States experienced a prolonged drought. Although dry periods are not uncommon in the Southwest, the drought of the 1950's was considerably more severe than any other in the region's recorded history. Some Arizona workers concluded that the drought of 1951-56 was one of the most severe in the past 350 years, and perhaps exceeded in severity only by the Great Drought of the late thirteenth century. Their findings would apply to southern New Mexico and western Texas.

The semidesert grassland is one of the major plant associations of western Texas, southern New Mexico, southeastern Arizona, and northern Mexico. Since detailed weather and vegetation records are available at the Jornada Experimental Range, it is possible to study the effects of the catastrophic drought of the early 1950's. Even the casual observer noticed that the perennial grasses completely or almost completely disappeared from large areas. Since the semidesert grassland is of major importance to the livestock industry, a study of the behavior of the native vegetation during drought is of paramount importance. These studies will lead to a better understanding of land capabilities.

Black grama is the major species on the upland sandy soils. During an early drought, 1916-18, the basal cover of black grama gradually declined to 42 percent of the original pre-drought cover. It practically recovered its original stand during two favorable growing seasons, 1919-20, then dropped very suddenly in the following two years of drought to the extremely low point of 11 percent of the original cover. The black grama cover remained low for the remainder of the second drought period,

1921-26, then increased markedly during the succeeding favorable years. In 1934, a single severe drought year, no new growth occurred on any of the black grama quadrats on the Jornada. The basal cover of black grama declined 77 percent between 1933 and 1935 as a result of the 1934 drought.

The climate on the Jornada Range is typical of arid regions. The average annual precipitation is 9 inches and the average during the summer growing season is 5 inches. Springs are generally dry and windy. Summer rainfall comes from convectional thunderstorms which are frequently localized and of high intensity. The average annual evaporation from a Weather Bureau pan is 90 inches or ten times the precipitation.

A vegetation survey, taken annually from 1941 through 1957, is the basis for a study of the drought of the early 1950's. Grass basal cover was estimated each autumn by 50-foot line-intercept transects. Yield estimates for each perennial grass species were obtained by clipping a 4-inch by 50-foot belt transect. Cover data reflect the previous year's growing conditions, while yield data are governed by stand and current year's growing conditions. For example, the first severe drought year was 1951 but this was not reflected in the cover estimates until 1952, but it was shown in the yield estimates of 1951.

Each vegetation observation, taken in the same general area each year, was related to a nearby rain gauge. In 1951, the July through September rainfall averaged 1.1 inches at the several rain gauges; in 1952, the average was 3.3 inches; in 1953, 1.5 inches; in 1954, 3.5 inches; in 1955, 3.7 inches; and in 1956, the average was 2.5 inches. The average annual precipitation for the 1951-56 period was only 54 percent of the long-time average.

The vegetation data were placed into sites according to soil type. The deep sands are underlaid by caliche at depths ranging from 36 to 50 inches. The dominant soil type in this unit has been identified as Onite loamy sand. The Cacique loamy sands have an indurated caliche layer at depths of 25 to 30 inches. Shallow sands are underlaid with caliche at depths of 10 to 18 inches. The major soil type in this stratum is Simona loamy sand.

On the deep sands site, black grama basal cover for 1941 through 1951 averaged 0.86 percent. The basal cover for the other perennial grasses, dropseeds and threeawns, averaged 0.26 percent. In 1952 black grama cover dropped to 0.29 percent; and stayed at that level during 1953. In 1954, it dropped to 0.01 percent and remained at that level for the remainder of the drought. The dropseeds and threeawns cover dropped to 0.03 percent in 1952, then in 1955 increased to 0.33 percent, but dropped in 1956 to 0.09 percent.

On the Cacique soils, black grama cover for the 1941-51 period averaged 0.94 percent. In 1952 it decreased to 0.33 percent and remained at about that level through 1957. The dropseeds and threeawns averaged 0.19 percent basal cover prior to the drought. Cover of these grasses

decreased to zero in 1952; it was 0.11 percent in 1954; 0.25 percent in 1955; 0.09 percent in 1956; and 0.19 percent in 1957.

On shallow sands, black grama cover for the 1941-51 period averaged 1.10 percent. In 1952 it dropped to 0.24 percent; increased in 1953 to 0.80 percent; decreased in 1954 to 0.34 percent; increased in 1955 to 1.31 percent; decreased in 1956 to 0.15 percent; and increased in 1957 to 0.51 percent. These data agree fairly well with the rainfall data. The dropseeds and threeawns cover averaged 0.29 percent prior to the drought. In 1952 it decreased to 0.03, then slowly increased until it was 0.42 percent in 1955, and then decreased again in 1956.

On deep sands the pre-drought black grama yields averaged 359 lb of air-dry herbage per acre. In 1951 it decreased to 148 lb and it continued to decrease until in 1955 the black grama yield was 12 lb/a. The yield for the other perennial grasses, the dropseeds and threeawns, averaged 112 lb/a before 1951. In 1951 it dropped to a trace and then gradually increased to 72 lb/a in 1956.

On the Cacique soils black grama yields for the 1941-50 period averaged 523 lb of air-dry herbage per acre. In 1951 it decreased to 186 lb and then declined steadily until in 1955 the black grama yields were 64 lb/a. In 1956 it increased to 214 lb/a. The dropseeds and threeawns yielded an average of 129 lb/a prior to the drought. In 1951 it dropped to virtually none. After 1952 it increased gradually until in 1955 the yields of dropseeds and threeawns were 73 lb/a.

On shallow sands, black grama yields for the 1940-50 period averaged 549 lb/a. In 1951 it dropped to 262 lb and in 1952 to 195 lb; it increased slightly in 1953 to 232 lb; but then decreased in 1954 to 126 lb/a. After that the black grama yield increased to 225 lb/a by 1956. The dropseeds and threeawns production on shallow sands averaged 160 lb/a prior to the drought. In 1951 it dropped to 11 lb/a and remained at that level for the remainder of the drought except for 1954 when it was 82 lb/a.

No site was favored by precipitation during the drought. Yet, effects on the vegetation were not the same over all sites. On deep sands the 1954-57 black grama cover was one to two percent of the pre-drought average. On Cacique soils the 1954-57 black grama cover was 26 percent of the pre-drought average. There is a direct relationship between drought damage and depth of soil. The vegetation on the deeper soils sustained much greater damage. This seems reasonable when it is realized that grass plants obtain moisture more readily from the surface 12 inches of soil. On deeper soils the roots become more extended and thus more susceptible to drought damage during years when there is only enough moisture in the surface area. Another point, probably the most important, is that the indurated caliche under these soils is almost impermeable and therefore the soil holds water, even above field capacity, until the plant uses it. Therefore, on shallow soils water is held at a more readily obtainable depth. This water is not lost by evaporation through capillary movement because there is essentially no movement

in these sands. Another point is that the water-holding capacity of the surface soil is low and thus, on the deeper sands, the moisture is more diffused throughout the profile.

The dropseeds and threeawns were even more susceptible to drought than black grama. In some of the strata none, or essentially none, were observed in the drought years. In the less severe drought years of 1954 and 1955, the dropseeds made a partial recovery from seedlings. These plants were subsequently reduced by the severe drought year of 1956. The threeawns were essentially eliminated by the drought. A discussion of the great drought would be incomplete without mention of the severe wind erosion as a result of drought damage to the perennial grasses. On the sandy soils, large areas left bare of vegetation by the drought began to erode with the spring winds. The sand would drift until it reached fences, mesquite plants, buildings, or other obstacles. Many grass plants not killed by moisture stress were killed by shifting sand.

We have been sampling selected areas within the three strata since 1958- 1959 (Table 1). On the deep sands (Onite site) a good stand of mesa dropseed developed in 1957. Excluding droughty 1960, perennial grass yields, primarily mesa dropseed, averaged 192 lb/a during the 1958-61 period. It dropped to 70 lb/a in 1962 even though it was a very wet year. During the droughty years of 1963-67 perennial grass yields averaged 30 lb/a. Even though precipitation was above average in 1968, production remained low until 1972. Grass yields averaged 359 lb/a for 1972-77.

The perennial grass production on the Cacique site averaged 419 lb/a for the years 1959, 1961, and 1962. For the 1963-67 period it averaged 193 lb/a. Grass yields averaged 358 lb/a for 1972-77.

On the Simona site, perennial grass production for 1958 and 1959 averaged 474 lb/a. In droughty 1960 it dropped to 215 lb/a. In wet 1961 and 1962 it averaged 585 lb/a. For the drier 1963-67 period it averaged 241 lb/a. Perennial grasses yielded 368 lb/a for 1972-77. Rainfall on this site was not as timely as on the Onite and Cacique sites.

Table 1 also shows yields of perennial grasses for the Reakor, Stellar, and Algerita sites. The former two sites are located about 75 yards apart and have the same rainfall. The Reakor site is dominated by burrograss, and the other two sites by tobosa. At the Reakor site, perennial grasses yielded 1955 lb/a for 1957-59; 474 lb/a for 1964-71; and 987 lb/a for 1972-75. At the Stellar site, it averaged 2831 lb/a for 1957-59; 1048 lb/a for 1964-71; and 2260 lb/a for 1972-75. Average tobosa yields at the Algerita site were: 3160 lb/a for 1957-59, 950 lb/a for 1963-71, and 1932 lb/a for 1972-75.

Since 1950 we have experienced three severe drought periods. The first was the Great Drought of 1951 through 1956 which was perhaps a one in 350 year occurrence. The next was a very severe drought for a relatively short period - September, 1959 through November, 1960. The third

Table 1. Crop year precipitation (October through September in inches) and perennial grass yields yields (lb/a) at six sites, Jornada Experimental Range, NM

| Year | Reakor-1/ | | Stellar-2/ | | Algerita-3/ | | Onite-4/ | | Cacique-5/ | | Simona-6/ | |
|---------|-----------|-------|------------|-------|-------------|-------|----------|-------|------------|-------|-----------|-------|
| | PPT | Yield | PPT | Yield | PPT | Yield | PPT | Yield | PPT | Yield | PPT | Yield |
| 1957 | 9.0 | 1690 | 9.0 | 3359 | 7.2 | 2923 | - | - | - | - | - | - |
| 1958 | 14.9 | 1482 | 14.9 | 3486 | 11.9 | 3018 | 17.8 | 180 | - | - | 14.6 | 463 |
| 1959 | 8.5 | 2694 | 8.5 | 1648 | 7.3 | 3540 | 8.6 | 195 | 7.4 | 382 | 10.7 | 484 |
| 1960 | 5.1 | 79 | 5.1 | 348 | 3.1 | 10 | 4.7 | 48 | 4.1 | 56 | 4.1 | 215 |
| 1961 | 8.8 | 673 | 8.8 | 873 | 11.0 | 2502 | 11.0 | 200 | 12.1 | 503 | 12.0 | 522 |
| 1962 | 11.6 | 1014 | 11.6 | 1147 | 8.2 | 1759 | 12.1 | 70 | 13.6 | 371 | 11.7 | 648 |
| 1963 | 9.3 | 1558 | 9.3 | 1487 | 5.9 | 224 | 6.1 | 35 | 4.8 | 88 | 7.8 | 210 |
| 1964 | 6.2 | 126 | 6.2 | 147 | 7.2 | 699 | 6.4 | 19 | 6.6 | 210 | 6.1 | 275 |
| 1965 | 6.0 | 62 | 6.0 | 13 | 5.7 | 473 | 4.9 | 8 | 5.5 | 155 | 5.4 | 138 |
| 1966 | 6.7 | 642 | 6.7 | 698 | 6.1 | 2690 | 8.3 | 57 | 9.0 | 288 | 8.9 | 421 |
| 1967 | 10.3 | 758 | 10.3 | 1970 | 8.4 | 490 | 7.1 | 33 | 4.8 | 224 | 8.0 | 161 |
| 1968 | 9.0 | 418 | 9.0 | 1335 | 9.1 | 633 | 12.4 | 33 | 9.4 | 369 | 8.9 | 133 |
| 1969 | 7.9 | 869 | 7.9 | 1840 | 12.2 | 2634 | 9.5 | 80 | 6.4 | 207 | 6.5 | 321 |
| 1970 | 5.7 | 193 | 5.7 | 411 | 7.9 | 569 | 8.1 | 174 | 6.2 | 229 | 6.6 | 181 |
| 1971 | 8.3 | 723 | 8.3 | 1970 | 5.4 | 134 | 7.4 | 64 | 6.6 | 223 | 5.8 | 212 |
| 1972 | 14.0 | 1173 | 14.0 | 3320 | 11.6 | 2106 | 13.2 | 505 | 10.1 | 374 | 11.5 | 397 |
| 1973 | 13.7 | 1073 | 13.7 | 1656 | 11.7 | 1546 | 13.7 | 341 | 11.5 | 275 | 11.4 | 158 |
| 1974 | 11.1 | 615 | 11.1 | 2016 | 13.9 | 1469 | 11.6 | 189 | 9.9 | 238 | 8.3 | 162 |
| 1975 | 13.1 | 1086 | 13.1 | 2046 | 11.5 | 2607 | 11.9 | 603 | 12.5 | 378 | 11.7 | 330 |
| 1976 | 9.8 | 442 | 9.8 | 920 | 10.6 | 898 | 9.7 | 289 | 8.6 | 436 | 9.4 | 342 |
| 1977 | 8.0 | 439 | 8.0 | 483 | 7.4 | 1143 | 9.2 | 228 | 10.3 | 447 | 12.6 | 820 |
| Average | 9.4 | 848 | 9.4 | 1484 | 8.7 | 1527 | 9.7 | 168 | 8.4 | 287 | 9.1 | 330 |

1/ Primarily burrograss

2/ Primarily tobosa

3/ Primarily tobosa

4/ Primarily mesa dropseed

5/ Mixture of mesa dropseed and black grama

6/ Primarily black grama

drought period, 1963-67, was not as severe as the 1951-56 drought but the vegetation was reduced to about the same levels.

On shallow sands, black grama cover was reduced to about 0.5 percent following the drought of 1951-56 and again during the 1963-67 drought. On Cacique soils black grama cover was reduced to about 0.25 percent during both drought periods.

On deep sands, black grama was virtually eliminated by the 1951-56 drought but there was a slight improvement during the wetter years of 1958-59 and 1961-62. On this site there was a rapid increase of mesa dropseed in 1957. Basal cover of mesa dropseed remained at about 0.75 percent through 1959, then began declining until it was at a very low level from 1963 to 1966. It appears now that it will be many years before black grama again begins to dominate this site. We will likely have some dropseed, particularly during wetter years, but production from year to year will fluctuate greatly. Consequently, stocking on this site must be at a new and lower level than prior to the drought of the early 1950's. We must have a crop of dropseed seedlings established every 3 or 4 years to maintain a satisfactory stand. On shallow sands, black grama cover had fully recovered from the 1951-56 drought by 1959.

There is little doubt that grass production varies widely from year to year, and decreases markedly during prolonged droughts. There must be considerable flexibility in ranch management to cope with these high levels of variability.