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RANGE CONSERVATION - TECHNICAL NOTES

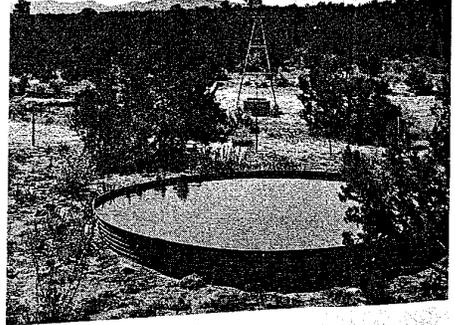
AERIAL CHEMICAL PLANT CONTROL



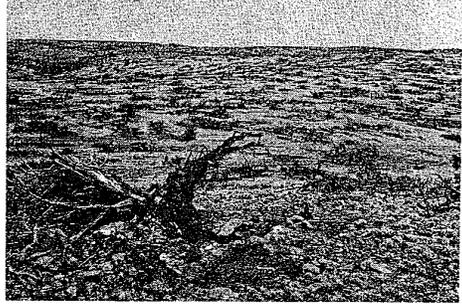
PROPER RANGE USE PAYS



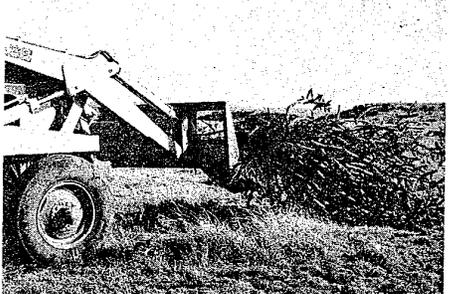
GOOD LIVESTOCK WATERING



CHAINING PINON JUNIPER



CHOLLA CONTROL



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NEW MEXICO

TECHNICAL NOTE NO. 5

September 1, 1966

SUBJECT: REPRINTS FROM THE JOURNAL OF RANGE MANAGEMENT

Attached are two reprints from the "Journal of Range Management". Knowledge of this type of research is valuable to a technician in carrying out his responsibilities.

I would suggest that in reading these papers, the summary be read first and then consider the body of the article next.

Several of the more important findings are: (1) The extensive use being made of forbs and some of the grasses previously considered inferior, (2) The wide difference in travel exhibited by the two breads studied.

These findings can have direct bearing on your proposed alternatives with a rancher.

Attachments

Distribution:
WUC's

Activities of Hereford and Santa Gertrudis Cattle on A Southern New Mexico Range¹

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Highlight

The Hereford cows spent more time grazing, less time walking, and traveled less distance than the Santa Gertrudis. When compared to results from other locations, there is no apparent relationship between grazing time and quantity of forage per unit area. There were generally 4 grazing periods: about midnight, from daybreak for the next 3 to 3½ hr, midday, and late afternoon for 3 to 3½ hr.

Only a few studies have compared the performance of two breeds of cattle on rangelands of the United States. Although Herefords are the dominant breed in the Southwest, cattle with some Brahman blood may be better adapted to the hot, arid environment. This study was conducted to determine the differences, if any, in performance of Hereford and Santa Gertrudis cattle on rangeland.

Methods

This 3-year study was conducted on the Jornada Experimental Range, 25 miles north of Las Cruces, New Mexico. The climate is typical of the arid phase of the semidesert grassland. There is an extremely variable precipitation, an abundance of sunshine, a wide range between day and night temperatures, and a low relative humidity. The average annual

precipitation at Headquarters is 9.01 inches and the average seasonal precipitation (July-September) is 4.99 in. The average maximum temperature for January is 55.6 F and for July 94.7. The average minimum temperature for January is 22.4 F and for July 64.2.

The major plant species are: burgrass (*Scleropogon brevifolius* Phil.); mesa dropseed (*Sporobolus flexuosus* (Thurb.) Rydb.); alkali sacaton (*Sporobolus airoides* (Torr.) Torr.); black grama (*Bouteloua eriopoda* (Torr.) Torr.); broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt. & Rusby); leather croton (*Croton corymbulosus* Engelm.); and soap tree yucca (*Yucca elata* Engelm.).

The study was initiated in November 1961. Two pastures were used. One contains 2,638 acres and the other 3,610 acres. Both pastures are relatively level, and in each, it is about 3½ miles from water to the far end of the pasture. Each breed was pastured separately and was rotated between the pastures each year about November 1. The test herd consisted of 15 cows of each breed born in 1959. However, additional animals of each breed were stocked as necessary to achieve proper grazing use. The stocking rate varied from 3 to 7 cows per section. A salt-bone meal mix was available near water. Small quantities of a ground concentrate mixture were fed from March 17 through July 3, 1964.

Bulls were with the cows from May 1 to October 1. Most of the Hereford cows calved during the late winter while the Santa Gertrudis cows calved throughout the late winter and spring.

The activities of a cow of each breed were observed for a 24-hour period every 4 weeks during the 3-

year period. In addition, from November 1961 to March 1963, a cow from each breed was observed every 4 weeks during the daylight hours. Observations were alternated between breeds. The cows to be observed were selected at random from the test herd of each breed and marked with white paint immediately before the observation period. Each cow in the test herd was observed before any one cow was observed the second time. The cows were observed from a vehicle equipped with a spotlight as an aid for nighttime observations. Two men observed the cows continuously and recorded the time to the nearest minute for each activity. The activities of the cows generally were not affected by the observers or the vehicle.

Results

The data for the 3 years were subdivided to obtain averages for 24-hour, daytime, nighttime, and seasonal activities. Confidence intervals (0.95) were computed for statistical comparisons of means.

The percent of time spent grazing includes grazing-standing and grazing-walking. The percentage shown for nursing also includes a small amount of grazing and standing-ruminating but most nursing time was standing-idle. The standing-idle percentage does not include any of the nursing time. The number of times watering is the actual number of times the cow drank from the water trough or from rain puddles. Rubbing includes the number of times the cows rubbed on rubbing devices and on shrubs. The percentage of time spent walking also includes a small amount of running. The time shown for standing-ruminating also includes a small amount of walking-ruminating.

Yearlong.—Table 1 shows the average activities for the Hereford and Santa Gertrudis cows for the 3-year period. On a 24-hour basis there were 37 observations of each breed. The Hereford cows spent significantly more time grazing and less time

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walking. On a yearlong basis it was estimated that the Hereford cows walked an average of 4.9 miles while the Santa Gertrudis cows averaged 7.8 miles during an average 24-hour period. The Hereford cows also did significantly more rubbing than the Santa Gertrudis cows.

On a daytime-nighttime basis, both breeds spent significantly more time grazing and standing-idle in the daytime, but there were no significant differences between breeds. They also both

watered and defecated significantly more times in the daytime. Conversely, both spent significantly more time ruminating, particularly lying-ruminating, at night.

Seasonal.—Table 2 shows the average seasonal activities for the Hereford and Santa Gertrudis cows. During the 3-year period there were nine or ten 24-hour observations during each season. The Santa Gertrudis cows spent significantly less time grazing in the winter than the

Hereford cows during any season. The Santa Gertrudis cows spent significantly more time standing-idle in the spring than in the fall, lying-idle in the winter than in the summer, and nursing calves in the summer than in the spring. The Herefords spent significantly less time walking in the fall than did the Santa Gertrudis during the fall, spring, and summer. The Santa Gertrudis spent more time walking in the summer than the Herefords in any season. It was estimated that the Herefords walked 5.3, 5.2, 4.6, and 4.3 miles during a 24-hour period in the fall, winter, spring, and summer seasons, respectively, while the Santa Gertrudis walked 8.0, 6.1, 8.3, and 9.1 miles during the same respective seasons.

An examination of the seasonal data for the daytime revealed that the Hereford cows spent more time ruminating in the fall than in the winter. The Herefords rubbed oftener in the winter and summer than they did in the fall and defecated oftener in the fall than in the spring. The Santa Gertrudis rubbed oftener in the winter than any other season.

An examination of the nighttime seasonal data showed that

Table 1. Yearlong activities of Hereford and Santa Gertrudis cows¹.

Item	24-Hour		Daytime		Nighttime	
	H ²	SG ²	H	SG	H	SG
Observations (no.)	37	37	58	58	37	37
Grazing (%)	42.8 ^b	37.2 ^a	49.9 ^b	46.5 ^b	34.7 ^a	29.6 ^a
Ruminating, total (%)	31.0 ^a	30.8 ^a	21.1 ^a	19.5 ^a	41.3 ^b	40.3 ^b
Standing-ruminating (%)	8.6 ^a	6.8 ^a	8.9 ^b	7.3 ^{ab}	8.5 ^{ab}	5.6 ^a
Lying-ruminating (%)	22.4 ^a	24.0 ^a	12.2 ^a	12.2 ^a	32.8 ^b	34.7 ^b
Standing-idle (%)	7.5 ^a	7.5 ^a	10.2 ^b	10.8 ^b	5.0 ^a	3.5 ^a
Lying-idle (%)	9.9 ^a	10.1 ^a	7.5 ^a	7.1 ^a	12.1 ^a	13.4 ^a
Walking (%)	6.5 ^a	12.1 ^b	9.2 ^{ab}	13.4 ^b	4.8 ^a	11.5 ^b
Nursing (%)	1.6 ^a	1.6 ^a	1.4 ^a	1.6 ^a	1.8 ^a	1.6 ^a
Nursing (no.)	2.7 ^a	2.4 ^a	1.2 ^a	1.1 ^a	1.4 ^a	1.3 ^a
Watering (no.)	1.0 ^a	1.5 ^a	0.8 ^b	1.3 ^b	0.1 ^a	0.2 ^a
Salting (no.)	0.1 ^a	0.5 ^a	0.1 ^a	0.5 ^a	0.0 ^a	0.0 ^a
Rubbing (no.)	1.1 ^b	0.1 ^a	0.6 ^b	0.1 ^a	0.6 ^{ab}	0.0 ^a
Defecating (no.)	6.5 ^a	6.5 ^a	4.1 ^b	4.2 ^b	2.8 ^a	2.5 ^a
Urinating (no.)	5.9 ^a	6.5 ^a	3.4 ^a	3.8 ^a	2.8 ^a	3.2 ^a

¹Entries on the same line having the same superscript are not significantly different (0.05 level). The 24-hour value should not be compared with either the daytime or nighttime values.

²H = Hereford, SG = Santa Gertrudis.

Table 2. Seasonal activities of Hereford and Santa Gertrudis cows¹.

Item	Fall		Winter		Spring		Summer	
	H ²	SG ²	H	SG	H	SG	H	SG
Observations (no.)	9	9	10	10	9	9	9	9
Grazing (%)	42.4 ^b	40.5 ^{ab}	40.8 ^b	31.8 ^a	42.5 ^b	38.0 ^{ab}	45.8 ^b	39.2 ^{ab}
Ruminating, total (%)	33.9 ^a	31.8 ^a	33.1 ^a	35.7 ^a	27.0 ^a	28.7 ^a	30.0 ^a	26.8 ^a
Standing-ruminating (%)	11.3 ^a	7.6 ^a	9.4 ^a	7.8 ^a	5.3 ^a	4.8 ^a	8.4 ^a	7.0 ^a
Lying-ruminating (%)	22.6 ^a	24.2 ^a	23.7 ^a	27.9 ^a	21.7 ^a	23.9 ^a	21.6 ^a	19.8 ^a
Standing-idle (%)	8.9 ^{ab}	4.5 ^a	7.1 ^{ab}	6.6 ^{ab}	7.8 ^{ab}	11.0 ^b	6.2 ^{ab}	7.9 ^{ab}
Lying-idle (%)	9.2 ^{ab}	9.0 ^{ab}	11.1 ^b	16.4 ^b	11.3 ^{ab}	8.4 ^{ab}	8.1 ^{ab}	6.0 ^a
Walking (%)	4.1 ^a	11.4 ^{bc}	7.2 ^{ab}	9.0 ^{abc}	7.8 ^{ab}	12.7 ^{bc}	7.0 ^{ab}	15.6 ^c
Nursing (%)	1.1 ^b	2.3 ^{bc}	0.0 ^a	0.0 ^a	3.1 ^{bc}	0.9 ^b	2.3 ^{bc}	3.3 ^c
Nursing (no.)	2.2 ^b	3.1 ^{bc}	0.0 ^a	0.0 ^a	4.0 ^{bc}	1.5 ^b	3.9 ^{bc}	5.2 ^c
Watering (no.)	1.4 ^{ab}	1.9 ^b	0.9 ^a	1.0 ^{ab}	0.6 ^a	1.0 ^{ab}	1.1 ^{ab}	2.0 ^{ab}
Salting (no.)	0.0 ^a	0.4 ^a	0.2 ^a	0.3 ^a	0.2 ^a	0.0 ^a	0.1 ^a	1.4 ^a
Rubbing (no.)	0.1 ^a	0.0 ^a	2.0 ^a	0.2 ^a	1.3 ^a	0.2 ^a	0.9 ^a	0.2 ^a
Defecating (no.)	7.4 ^a	6.1 ^a	7.0 ^a	6.6 ^a	5.1 ^a	6.3 ^a	6.4 ^a	7.0 ^a
Urinating (no.)	5.4 ^a	8.1 ^a	5.5 ^a	5.4 ^a	6.4 ^a	4.9 ^a	6.3 ^a	7.9 ^a

¹Entries on the same line having the same superscript are not significantly different (0.05 level).

²H = Hereford, SG = Santa Gertrudis.

CATTLE ACTIVITIES

the Herefords walked less in the fall than in the spring and summer. During the fall the Santa Gertrudis walked more than the Herefords at night.

Miscellaneous Observations.—When the cattle grazed plants that had both green and dry portions, they would try to eat only the green portions, frequently letting the dry portion drop from their mouths. This is probably one of the major reasons why a clipped forage sample is generally not a good approximation of the cow's diet.

The Herefords were frequently in small groups, 4 to 8 cows per group, while the Santa Gertrudis all stayed together more frequently. When the small groups of Herefords came together, as at water, they would regroup. The activities of the Santa Gertrudis as a group were more uniform than those of the Herefords; e.g. all of the Santa Gertrudis cows would graze more nearly at the same time, lie down at the same time, etc. When the Santa Gertrudis cows lay down, one cow sometimes made the others stand up. The Santa Gertrudis cows walked faster and ran more than the Hereford cows. The Santa Gertrudis cows frequently permitted calves other than their own to nurse them, but the Hereford cows only rarely allowed this.

The Santa Gertrudis were easier to round-up than the Herefords because they were usually together, and once they were started toward the corrals they generally kept going until they arrived. However, the Santa Gertrudis cows were more difficult to handle in the corrals in operations such as weighing and taking blood samples.

During and shortly after rainfall, cattle drank water from any low place where water collected such as wheel tracks, paths, foot prints, and natural depressions. On some winter days the cattle did not water.

Discussion and Conclusions

A study of the activities of range animals is important to an understanding of animal performance. Hancock (1953) reported that the behavior of an animal on rangeland is conditioned by factors such as the environment, quantity of forage, digestibility of forage, forage species available, and the individual animal. In this study the activities of range animals varied little by season. The Santa Gertrudis spent a little less time grazing in the winter and more time lying-idle than in other seasons; this may be related to the weather but probably is because they had no nursing calf. There was little seasonal difference in nighttime grazing, the Herefords actually grazed more in the fall, which would also indicate that the weather had little effect on the activities of the animals. An examination of the data for the 6 hottest days of the 3-year period (maximum temperatures ranged from 95 to 107 F) showed no difference in the grazing time between breeds or when compared to cooler days. Ittner et al. (1954) reported that the Brahman and Brahman crosses grazed more than Herefords and Shorthorns during the daytime in summer on irrigated pasture in the Imperial Valley of California.

In this study the 24 hr period was divided generally into the following grazing intervals: about midnight, from daybreak for the next 3 to 3½ hr, midday, and late afternoon for 3 to 3½ hr. The major difference for both breeds between winter and summer was the length of time spent grazing at midday; during the winter it was generally 1 to 1½ hr, while in summer it was generally 2 to 2½ hr. The major difference between breeds was the time spent grazing about midnight; the Hereford cows generally spent about 2½ hr grazing at this time, while the

Santa Gertrudis cows only spent about 1 hr.

The time spent grazing during the summer is similar to Oklahoma results (Dwyer, 1961) and yearlong grazing was similar to California results (Wagnon, 1963). This would indicate that there is not a close relationship between grazing time and quantity of forage per unit area because both of those areas have higher production than the experimental area in this study. The winter grazing was less than Texas results (Box et al., 1965) where forage production is also higher than on the experimental area. The perennial grass herbage production on the experimental pastures averaged 139 lb/acre of air-dry herbage over the 3-year period.

Loifgreen et al. (1957) presented evidence that the ratio of ruminating time to grazing time is related to the TDN content of the forage grazed. In this study the ratios for the Hereford cows were 0.80, 0.81, 0.64, and 0.66 for the fall, winter, spring, and summer, respectively, while for the Santa Gertrudis cows they were 0.79, 1.12, 0.76, and 0.68. All ratios except the one for the Santa Gertrudis during the winter, agree with California results where the overall ratio was 0.71 (calculated from data presented by Wagnon, 1963). The 1.12 ruminating-to-grazing ratio, calculated for the Santa Gertrudis during the winter, agrees closely with a ratio of 1.08 calculated from Oklahoma data presented by Dwyer (1961). Each breed spent about 31% of the time ruminating, about 75% of which was while lying. The total time spent resting (ruminating plus idling) was about 48.5% of the time for each breed. About 68% of the resting time was spent lying.

One of the major differences between breeds was the time spent walking and the distances traveled. The Santa Gertrudis

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spent nearly twice as much time walking as the Herefords and traveled an average of about 3 miles more per day. The estimates of distance traveled by the Herefords are surprisingly similar to those made in Oklahoma (Dwyer, 1961) and in Texas on a non-supplemented area (Box et al., 1965) even though those study areas were smaller than the pastures used in this study. This suggests that the approximate upper limit of travel for Hereford cattle is 4 to 5 miles. The additional travel by the Santa Gertrudis was particularly obvious within a day after some rainfall when their tracks could be seen at widely spaced locations within the pasture. This was not true in the pasture stocked with Herefords.

The Santa Gertrudis spent more time nursing calves in the summer than in the spring because they calved late.

The average number of daily defecations varied seasonally from 5 to 7 with no difference between the 2 breeds. This is substantially lower than reported by Dwyer (1961) for prairie rangeland during the summer; by Wagnon (1963) for green forage on California ranges; and by Johnstone-Wallace and Kennedy (1944) for Kentucky bluegrass-white clover pastures. This would indicate a relationship between number of defecations and

the succulence of vegetation. The number of defecations on dry winter forage in the Texas Panhandle (Box et al., 1965) was lower than reported in this study. In this study the average number of urinations varied seasonally from 5 to 8. This is similar to results reported by Dwyer (1961); lower than reported for green California range (Wagnon, 1963); and higher than reported for dry California range (Wagnon, 1963) and dry Texas range (Box et al., 1965). This may also be related to the succulence of vegetation.

Summary

A 3-year study was made of the activities of Hereford and Santa Gertrudis cattle under southern New Mexico conditions. The Herefords spent significantly more time grazing than the Santa Gertrudis, particularly about midnight, but there was no evidence that weather conditions affected the grazing time of either breed. Actually both breeds grazed more at midday during the summer than in the winter. In comparing results from other locations, there seems to be no close relationship between grazing time and quantity of forage per unit area.

One of the major differences between breeds was that the Santa Gertrudis spent more time walking (12.1% vs. 6.5%), and

traveled further (7.8 miles vs. 4.9 miles), than the Herefords.

When the number of defecations and urinations are compared with other locations, and when a relationship with degree of forage maturity is assumed, it would indicate that the forage consumed yearlong was intermediate between dry, leached forage and succulent, green forage.

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Species Preference of Hereford and Santa Gertrudis Cattle on A Southern New Mexico Range¹

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Highlight

The species preferences of Hereford and Santa Gertrudis cows were observed during a 3-year period. The cattle grazed a variety of species, undoubtedly an important factor affecting nutritional status. They ate, to some extent, all available species. There was no apparent difference between breeds in the quantity of coarse plants consumed.

The species grazed by livestock and the species preferred during various seasons are important in formulating grazing management plans and for nutritional studies. Season of growth, succulence, abundance, and nutritive qualities are plant properties influencing species preference. Tribe (1952) reported that in animals, age, stage of pregnancy, general physical condition, and hunger also affect grazing preference.

The purpose of this portion of the overall study was to determine the plants grazed by cattle during the various seasons.

Methods and Materials

This study was conducted on the Jornada Experimental Range, 25 mi north of Las Cruces, New Mexico. See Herbel and Nelson (1966) for a general description of the study area, for details on management of

¹Cooperative investigations of the Crops Research Division, Agricultural Research Service, U. S. D. A., and the Animal Science Department, New Mexico Agricultural Experiment Station. Partially supported by Western Regional Research Project W-34. Published as Journal Series No. 238, Agricultural Experiment Station, New Mexico State University.

the test herd, and for the methods used in observing the cows. At the same time the activities of the Hereford and Santa Gertrudis cows were being observed, their species preferences were noted. There were 58

observations of each breed over the 1961-64 study period. During daylight hours, while the cattle were grazing, we noted the species being grazed at 4-min intervals. Species grazed at nighttime were not noted. Samples similar to the grazed portions were also collected for chemical analyses which will be reported in another paper.

Since the species grazed depends on available vegetation, we sampled the experimental area annually during the summer by means of 100-ft line-intercept transects (Canfield, 1941). The data were stratified according to soil type. Fig. 1 shows the soil types on the experimental area (pastures 10 and 11). Names used in describing these soils are tentative, pending final correlation.

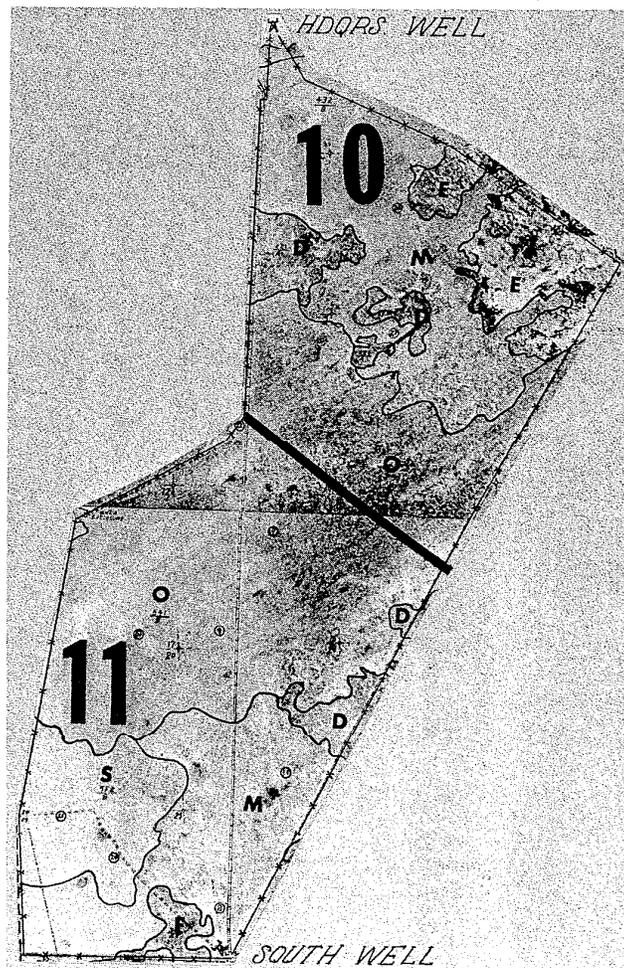


FIG. 1. Soil types on the experimental area (pastures 10 and 11 of the Jornada Experimental Range).

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The soils were described as follows (Soil Conservation Service, 1963):

D. Hoban silt loam, 0 to 1% slopes.—This is a moderately deep to deep, light-colored, calcareous soil that has a silty surface and moderately fine-textured, slowly permeable subsoil. Moderate to strong lime (calcium carbonate) zones usually occur at depths of 20 in and below. It occurs in the lower parts of the Jornada basin and receives some flood water during severe thunderstorms.

E. Dona Ana complex, 0 to 3% slopes.—The principal soils of this mapping unit are deep and calcareous with medium-textured surfaces over weakly developed, moderately fine-textured, slowly permeable subsoils. Prominent horizons of calcium carbonate accumulations occur below 25 in. The landscape is traversed by a series of erosional escarpments which range in height from 6 in to 7 ft. In many places at the foot of the escarpments accumulations of sand have formed a narrow, sandy ridge, varying from a few inches to several feet thick over fine underlying material.

F. Continental loam, 0 to 3% slopes.—This is a deep to moderately deep soil with a medium-textured surface over well-developed, clayey, slowly permeable subsoil. Strong lime zones occur below 26 in.

M. Turney sandy loam, 1 to 3% slopes.—This is a deep to moderately deep, light-colored, calcareous soil with sandy surface over weakly developed, moderately permeable, sandy clay loam subsoil. A prominent lime zone usually occurs below 20 in. Surface soils were wind-shifted in many places.

O. Banbar loamy fine sand, 1 to 3% slopes.—This soil is deep with moderately sandy surfaces over reddish, moderately permeable, sandy clay loam subsoils. Accumulations of lime are frequent at depths below 16 to 20 in. The surface is very susceptible to wind erosion.

S. Cacique loamy fine sand, 1 to 3% slopes.—These are mostly moderately deep soils with moderately sandy textured surfaces, with permeable subsoils. The soils are underlain with discontinuous layers of indurated caliche. In many places, due to rodent activity, caliche fragments have been mixed throughout the soil profile.

Table 1. Average basal cover (1961-64) by soil types for pastures 10 and 11 in units of 0.01%.

Species	Soil type										
	D		E		F		M		O		S
	10 ¹	11 ¹	10	11	10	11	10	11	10	11	
Perennial Grasses											
<i>Aristida longiseta</i>	0.1	1.5	4.3	4.7	2.4	1.9	0.1	0.1	1.6		
<i>Bouteloua eriopoda</i>	1.7	1.9	0.9	0.7	1.8	9.3	3.9	2.9	25.6		
<i>Hilaria mutica</i>	24.4	7.7	13.9	6.4	1.4	4.2	—	0.4	0.3		
<i>Scleropogon brevifolius</i>	137.7	68.6	63.4	66.0	22.0	10.0	0.2	1.3	0.2		
<i>Sporobolus airoides</i>	1.6	0.7	1.6	—	5.1	0.2	0.3	0.2	0.6		
<i>S. flexuosus</i>	0.7	1.2	5.4	0.1	4.7	6.3	8.6	16.9	12.8		
Others	2.7	3.4	3.9	4.8	3.7	6.1	0.2	1.0	3.8		
Annual Grasses											
<i>Bouteloua barbata</i>	0.1	—	0.3	—	1.0	T	0.5	1.7	0.5		
Perennial Forbs											
<i>Croton corymbulosus</i>	0.2	1.3	1.0	1.0	2.1	0.8	2.6	0.9	1.6		
<i>Lesquerella fendleri</i>	T	0.1	0.1	—	—	—	—	0.2	—		
<i>Perezia nana</i>	1.0	1.1	0.7	0.3	0.1	0.1	—	0.1	0.1		
<i>Psilostrophe tagetinae</i>	0.1	—	—	0.1	0.1	0.2	0.6	0.4	0.4		
<i>Sphaeralcea subhastata</i>	0.3	0.2	0.2	0.1	0.3	0.4	0.3	—	—		
Others	0.5	1.9	0.8	1.9	1.9	2.1	2.1	2.0	1.4		
Annual Forbs											
<i>Corispermum nitidum</i>	—	—	—	—	0.6	—	1.5	0.6	—		
<i>Dithyrea wislizeni</i>	—	—	—	—	—	T	T	0.4	T		
<i>Iva dealbata</i>	—	0.1	0.6	—	0.1	0.2	—	—	—		
<i>Salsola kali</i>	0.6	0.5	1.7	5.0	1.3	3.5	2.3	2.3	5.5		
Others	0.4	1.5	0.5	0.8	1.0	0.8	1.6	3.0	2.3		
Shrubs											
<i>Ephedra trifurca</i>	—	1.2	1.8	—	0.6	0.1	0.1	0.4	0.1		
<i>Gutierrezia sarothrae</i>	0.8	0.5	0.8	0.2	2.7	4.5	4.3	4.5	4.5		
<i>Yucca elata</i>	—	—	—	—	2.8	0.4	1.5	3.3	0.6		
Others	—	0.2	6.1	—	1.5	1.3	1.1	3.6	4.4		

¹10 = Pasture 10; 11 = Pasture 11.

Table 2. Average seasonal preference (%) for grasses by Hereford and Santa Gertrudis cows for the 1961-64 study period.

Species	Fall		Winter		Spring		Summer	
	H ¹	SG ¹	H	SG	H	SG	H	SG
<i>Aristida longiseta</i>	5.1	2.9	0.4	1.2	7.3	4.7	4.6	4.7
<i>Bouteloua eriopoda</i>	6.5	5.2	19.3	26.8	2.2	4.2	4.5	6.4
<i>B. curtipendula</i>	—	—	—	0.1	—	—	—	—
<i>Hilaria mutica</i>	0.6	4.2	—	1.7	1.0	0.7	8.8	14.5
<i>Muhlenbergia arenacea</i>	0.8	2.0	—	2.6	—	—	2.9	0.5
<i>M. porteri</i>	—	0.6	—	—	—	—	—	—
<i>Panicum hallii</i>	6.1	0.6	0.4	0.3	—	—	—	—
<i>P. obtusum</i>	0.8	0.5	—	0.4	—	—	3.1	1.3
<i>Scleropogon brevifolius</i>	6.9	11.5	3.7	14.1	0.1	7.5	11.4	15.5
<i>Sporobolus airoides</i>	4.9	3.9	2.6	4.0	12.7	25.8	8.0	11.4
<i>S. flexuosus</i>	15.7	11.0	14.2	11.4	11.7	13.6	28.1	12.8
<i>Tridens pulchellus</i>	1.1	3.1	1.9	0.5	—	1.9	—	4.9
Total perennial grasses	48.5	45.5	42.5	63.1	35.0	58.4	71.4	72.0
<i>Bouteloua aristidoides</i>	—	—	—	—	—	—	—	0.1
<i>B. barbata</i>	1.7	3.3	7.1	1.9	—	—	—	9.4
<i>Munroa squarrosa</i>	—	0.5	—	—	—	—	—	—
Total annual grasses	1.7	3.8	7.1	1.9	—	—	—	9.5

¹H = Herefords; SG = Santa Gertrudis.

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Table 1 shows the average basal cover for 1961-64 for the 2 pastures. The cover for the perennial grasses listed under "others" consisted primarily of ear muhly (*Muhlenbergia arenacea* (Buckl.) Hitchc.) and fluffgrass (*Tridens pulchellus* (H.B.K.) Hitchc.) but with smaller amounts of several others. The "others" perennial forbs were primarily desert bailey (*Baileya multiradiata* Harv. & Gray), trailing four-o'clock (*Allionia incarnata* L.), *Chamaesaracha coniodes* (Moric.) Britt., and rocky mountain zinnia (*Zinnia grandiflora* Nutt.) but with lesser amounts of several others. The major species included in other annual forbs were whitestem stickleaf (*Mentzelia albicaulis* Dougl.), purple roll leaf (*Nama hispidum* Gray), and white eriogonum (*Eriogonum rotundiflora* Benth.).

Because of droughty conditions in 1963 and 1964, the estimates of cover declined during the study period. Sixweeks grama (*Bouteloua barbata* Lag.) occurred primarily in 1962, with very small amounts in 1961 and 1964, although a substantial amount emerged after the sampling was completed in July of 1963 and 1964. Russianthistle (*Salsola kali* L.) was found only in 1961 and 1962.

Results

Each day a cow was observed, there generally were 70 to 90 observations of the species being grazed. Tables 2 and 3 show the average species preference as a percentage of the total number of observations for each season for the 1961-1964 study period. The data are presented for both the Hereford and Santa Gertrudis cows for each season.

Perennial Grasses.—On a year-long basis, Herefords were observed grazing perennial grasses 49.4% of the time while for the Santa Gertrudis it was 59.7%. The major period of growth for the perennial grasses shown in Table 2 is during the summer. However, the following are green during the spring and late fall of the years having available soil moisture: alkali sacaton (*Sporobolus airoides* (Torr.) Torr.), red threeawn (*Aristida longiseta* Steud.), tobosa (*Hilaria mutica*

Table 3. Average seasonal preference (%) for forbs and shrubs by Hereford and Santa Gertrudis cows for the 1961-64 study period.

Species	Fall		Winter		Spring		Summer	
	H ¹	SG ¹	H	SG	H	SG	H	SG
<i>Allionia incarnata</i>	—	0.6	—	—	—	—	2.2	—
<i>Bahia absinthifolia</i>	1.2	—	—	0.1	0.9	—	—	—
<i>Baileya multiradiata</i>	1.0	1.6	—	—	—	—	0.4	2.4
<i>Chamaesaracha coniodes</i>	—	—	—	—	1.8	—	—	—
<i>Cirsium ochrocentrum</i>	1.4	0.3	—	—	—	—	—	—
<i>Croton corymbulosus</i>	5.9	12.3	2.8	2.9	7.3	12.0	11.4	10.5
<i>Erysimum capitatum</i>	—	1.0	—	—	—	—	—	—
<i>Lesquerella fendleri</i>	0.4	—	3.7	0.3	0.8	1.0	—	—
<i>Melampodium leucanthum</i>	1.6	—	—	—	0.7	0.8	0.3	—
<i>Perezia nana</i>	2.9	2.7	—	0.2	—	—	—	—
<i>Psilostrophe tagetinae</i>	4.5	7.3	2.5	5.2	16.4	10.7	0.6	1.4
<i>Solanum elaeagnifolium</i>	1.8	0.2	—	—	—	—	—	—
<i>Sphaeralcea subhastata</i>	6.8	1.0	0.2	—	0.5	0.3	—	0.1
<i>Zinnia grandiflora</i>	2.4	1.4	0.5	—	—	—	0.5	1.2
Total perennial forbs	29.9	20.4	9.7	8.7	28.4	24.8	15.4	15.6
<i>Aphanostephus ramosissimus</i>	—	—	—	—	—	0.4	—	—
<i>Corispermum nitidum</i>	0.1	—	8.8	6.0	—	—	—	—
<i>Cryptantha crassisejala</i>	—	—	—	—	6.1	—	—	—
<i>Descurainia menziesi</i>	—	—	—	0.8	—	—	—	—
<i>Dithyrea wislizeni</i>	—	3.0	5.9	2.2	0.3	—	—	—
<i>Gutierrezia sphaerocephala</i>	1.2	—	—	—	—	—	—	—
<i>Hoffmannseggia densiflora</i>	0.4	—	—	—	—	—	—	—
<i>Iva dealbata</i>	3.2	7.2	—	1.3	—	0.5	—	—
<i>Kallstroemia hirsutissima</i>	—	—	—	—	—	—	—	0.1
<i>Mentzelia albicaulis</i>	—	—	1.9	—	1.4	—	—	—
<i>Nama hispidum</i>	—	—	—	—	0.3	0.6	—	—
<i>Phacelia intermedia</i>	—	—	—	—	—	0.2	—	—
<i>Salsola kali</i>	6.1	4.2	1.0	0.7	3.7	3.1	7.1	1.1
<i>Tribulus terrestris</i>	0.4	—	—	—	—	—	—	—
Total annual forbs	11.4	14.4	17.6	11.0	11.8	4.8	7.1	1.2
<i>Atriplex canescens</i>	0.5	0.1	—	—	0.1	—	—	0.2
<i>Ephedra trifurca</i>	4.5	4.8	2.0	0.6	2.3	—	0.8	0.2
<i>Flourensia cernua</i>	—	2.0	0.9	—	—	—	0.6	—
<i>Gutierrezia sarothrae</i>	1.0	—	0.6	0.2	3.1	0.1	—	—
<i>Prosopis juliflora</i>	—	—	0.2	—	—	—	0.8	1.2
<i>Yucca elata</i>	2.4	0.9	19.3	14.4	19.3	11.7	3.7	0.3
Total shrubs	8.4	7.8	23.0	15.2	24.8	11.8	5.9	1.9

¹H = Herefords; SG = Santa Gertrudis

(Buckl.) Benth.), and mesa dropseed (*Sporobolus flexuosus* (Thurb.) Rydb.).

Red threeawn was grazed when it was green during the spring, summer and fall. It was used by both breeds during the spring of 1962 (the only spring having appreciable moisture during the study period) and the summer and late fall of all 3 yr.

Tobosa was preferred during the summer and early fall. The Santa Gertrudis cows also grazed it each February during the

study period. They were observed grazing it about twice as much as the Herefords each year.

Alkali sacaton was grazed in spring and summer all 3 yr with less use in the winter of 1962 and fall of 1964 by both breeds. It was more prevalent in pasture 10 than in pasture 11 (Table 1) and the breeds were observed using it about the same in each pasture. The Santa Gertrudis cows were in pasture 10 two years during the study period.

Mesa dropseed was more abun-

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dant in pasture 11 than in pasture 10. It was grazed throughout the year.

Black grama (*Bouteloua eriopoda* (Torr.) Torr.) was preferred in winter, probably because it has green culms throughout the year. Other species are apparently more palatable at other times. Reduced use of black grama in 1964 corresponded to a decline in cover.

Burrograss (*Scleropogon brevifolius* Phil.), possibly an underrated forage plant, was grazed throughout the year, although a little less in the spring than in the other seasons. It was more abundant in pasture 10 than in pasture 11. Use of it increased during droughty 1963 and 1964.

The other perennial grass species shown in Table 2 were only minor components of the available species. The Herefords were observed grazing Hall's panicum (*Panicum hallii* Vasey) 24.4% of the time during the fall of 1963. It is a short-lived perennial that was not available to the cows except in the fall and early winter of that year. The Santa Gertrudis cows grazed more of the coarse grasses, tobosa and burrograss, than the Hereford cows.

Annual Grasses. — Sixweeks grama, a summer annual, was used in small amounts in the fall of 1961 by the Santa Gertrudis, by both breeds in the winter of 1962, and by the Herefords in the early fall of 1963. The cattle were observed grazing a considerable amount of it when it was dormant in the winter of 1964. This latter use was probably due to a shortage of other, more palatable, species at that time. The Santa Gertrudis cows also made considerable use of sixweeks grama in the late summer of 1964. The other annual grasses shown in Table 2 were very minor components of the species growing in pastures 10 and 11.

Perennial Forbs.—On a year-

long basis, both breeds were observed grazing perennial forbs about 20% of the time. All of the perennial forbs shown in Table 3 grow during the summer rainy season and most of them will make some growth in the spring seasons having sufficient moisture. Two, bladderpod (*Lesquerella fendleri* (Gray) Wats.) and western wallflower (*Erysimum capitatum* (Dougl.) Greene), make most of their growth in the years having winter-spring moisture.

Bladderpod was more abundant in pasture 11 than in pasture 10. The Herefords were observed grazing it November 1961 through February 1962, June 1962, and November 1963. The Santa Gertrudis grazed it in January and April 1963. It was not present in the droughty winter-spring of 1964. The Santa Gertrudis cows used a small amount of western wallflower in November and December, 1961.

Trailing four-o'clock was grazed only in September of 1964 even though it was available in other years.

In one observation in September, 1962 the Santa Gertrudis grazed desert baileya 43.7% of the time. Normally, it made up only a small portion of the diet in late summer and early fall.

Chamaesaracha coniodes was observed being grazed only on April 3, 1963 by the Herefords, even though it was present in the other years. During the fall of 1961, mature thistle (*Cirsium ochrocentrum* Gray) was grazed in the early morning hours when dew softened the stickers.

Leatherweed croton (*Croton corymbulosus* Engelm.) was grazed throughout the year, but less during the winter than in other seasons. On several occasions it made up 50% of the grazed plants.

Desert-holly (*Perezia nana* Gray) was a minor part of the diet in late fall and early winter after it matured. Woolly paper-

flower (*Psilostrophe tagetinae* (Nutt.) Greene) was eaten primarily during the fall, winter, and spring of 1962-63. During several observations it made up over 50% of the grazed plants.

Globemallow (*Sphaeralcea subhastata* Coult.) was grazed primarily by the Herefords in the falls of 1961 and 1963 while they were in pasture 11. It occurred about equally in both pastures. Rocky mountain zinnia was used primarily in the late fall and early winter each year except that both breeds made some use of it during the summer of 1962. The remaining perennial forbs shown in Table 3 were only minor components of the available species.

Annual Forbs.—The following annual forbs, shown in Table 3, grow during the summer rainy season: faint crown (*Aphanostephus ramosissimus* DC.), tickseed (*Corispermum nitidum* Kit.), annual snakeweed (*Gutierrezia sphaerocephala* Gray), sumpweed (*Iva dealbata* Gray), hairy caltrop (*Kallstroemia hirsutissima* Vail.), and puncturevine (*Tribulus terrestris* L.). Russianthistle emerges primarily in late winter in years having precipitation at that time. The other annual forbs shown in Table 3 make most of their growth in the spring in the years having spring precipitation.

Tickseed, relished during the winter of 1961-62 apparently because the plants had much seed, did not grow in any other year of this study. Deer's tongue (*Cryptantha crassiseptala* (Torr. & Gray) Greene) made up 55% of the Herefords diet on April 19, 1964, the only time it was observed being grazed.

Wislizenus spectaclepod (*Dithyrea wislizeni* Engelm.) was grazed in the winters of 1962 and 1963 by the Herefords and the late fall and winter of 1962-63 by the Santa Gertrudis. Sumpweed was used primarily in the fall and early winter of 1961-62.

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It did not occur in the other years. Whitestem stickleaf occurred only in pasture 11 in 1961 and 1962. It was grazed by the Herefords in the winter and early spring of that year.

Russianthistle was grazed primarily during the spring, summer, and fall of 1962. The Herefords ate about twice as much of this species as the Santa Gertrudis even though there was an abundance of it in both pastures in 1962.

Shrubs and Shrub-like Plants.—The Herefords grazed these plants, particularly soap tree yucca (*Yucca elata* Engelm.), more than the Santa Gertrudis. Soap tree yucca was eaten primarily in the winter and spring, when the faces of the cattle that eat the leaves often become green. Increased use of it was made in the dry winter-spring of 1964 when it sometimes made up 70% of the grazed plants. In late spring and summer, if the plants bloom, the cattle particularly relish the flowers and flower stalks. They will fight for them and, if necessary, stand on their hind legs to reach them.

The major use of longleaf mormontea (*Ephedra trifurca* Torr.) was in the late fall and early winter. The Herefords also made some use of it in the spring and early summer of 1964 when other forage was in short supply.

The fruits of broom snakeweed (*Gutierrezia sarothrae* (Pursh) Britt. and Rusby) were used by both breeds. On one occasion, March 31, 1962, the Herefords were observed eating it 55% of the time.

Small amounts of honey mesquite beans (*Prosopis juliflora* (Swartz) D.C. var. *glandulosa* (Torr.) Cockerell) were eaten on 3 occasions.

Discussion and Conclusions

Because of favorable moisture conditions the more ephemeral

species, annuals and short-lived perennials, occurred primarily in 1961 and 1962. The cattle grazed such plants as russianthistle, tick-seed, thistle, and sixweeks grama even after they were matured, particularly when they were softened by dew in the early morning hours.

Burrograss was readily grazed, particularly when some of the other species had been reduced by drought. Heretofore, it had been considered a grass of little value.

The cattle grazed black grama primarily during winter and tobosa during summer. This coincides with the recommended seasons of use for black grama and tobosa ranges (Paulsen and Ares, 1962).

There was no apparent difference in the total percentage of coarse plants grazed by the 2 breeds. The Santa Gertrudis ate more of the coarse grasses but the Herefords consumed more russianthistle and soap tree yucca.

The cattle grazed leatherweed croton, woolly paperflower, *Wislizenus spectabile* pod, russianthistle, longleaf mormontea, and soap tree yucca during the winter and spring when these plants contain a considerable amount of green material. This is probably why there is usually an adequate amount of carotene and protein in the diet of cows during the winter-spring period in this area (Watkins et al. 1950). Even in the dry winter-spring periods when the forbs are not growing, soap tree yucca, longleaf mormontea, and fourwing saltbush supply considerable amounts of carotene and protein. Thus, it appears that yearlong ranges having some forbs and desirable shrubs furnish the livestock with a better diet than do pure grass ranges.

The cattle ate, to some extent, all available species. Plants such as broom snakeweed, honey mes-

quite, and tarbush (*Flourensia cernua* DC.) were not grazed as much as the others.

Summary

The grazing preferences of Hereford and Santa Gertrudis cows were observed during a 3-year period. Average basal cover of the vegetation by soil type is presented to show plant species available for grazing.

The cattle grazed a variety of species, undoubtedly an important factor in their diets. During the winter and spring, the cattle grazed a number of forbs and shrubs not previously known to have been grazed in significant amounts. Some mature and dry species were grazed, particularly while softened by dew.

The cattle ate all available species to some extent. There was no apparent breed difference in the percentage of coarse plants grazed. Although the Santa Gertrudis consumed more of the coarse grasses, the Herefords ate more russianthistle and soap tree yucca.

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