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Response of Deer and Livestock to Controlled Grazing in Central Texas

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Highlight

White-tailed deer welfare and production under various intensities of continuous-use grazing by combined cattle, sheep, and angora goats was studied in the Edwards Plateau region of Texas. Under poor range conditions continuous grazing by combined classes of livestock adversely effected deer production through competition for food. Livestock were more efficient competitors for native forage than deer.

The effect of livestock grazing on deer production is a question that has gained increasing importance in the Edwards Plateau Region of west-central Texas. This ecologic region of some 26,000 square miles supports high densities of white-tailed deer *(Odocoileus virginianus)* along with combined classes of cattle, sheep, and goats.

Since the introduction of livestock in the 1800's range vegetation has changed. Under heavy domestic stocking rates, ranges have deteriorated until "the number of livestock which can be grazed on most Texas rangelands today is less than half the number carried in 1900" (Merrill, 1959). The change in vegetation from grassland to woodland has favored deer. As late as 1875 deer were still regarded as scarce in the northern sector of the Plateau, and their increase was slow until the 1940's (Hahn, 1945). Today a deer to 3 acres (or 213 per section) is not uncommon.

Competition between deer and livestock in the Edwards Plateau is critical, brought about by the remarkably similar diets of sheep, goats, and deer in combination with a relatively gentle topography that allows deer and livestock to occupy the same range (McMahan, 1961).[2]

The influence of livestock grazing practices on deer was formerly based mainly on general observations. Low fawn crops, poor quality carcasses and heavy death losses have been noted where deer occupy heavily grazed or poor ranges in the western and northeastern states (Julander, et al. 1961; French, et al. 1955) but objective information on deer welfare and production as influenced by combined classes of livestock was lacking in this region. To begin research on these relationships, the Texas Parks and Wildlife Department in 1955 constructed a series of experimental pastures for the purpose of studying deer response to different intensities of grazing by livestock.

Study Area and Methods

The Kerr Wildlife Management Area is located at Hunt, Kerr County and is basically representative of the surrounding region of the Edwards Plateau. Mean annual precipitation on the study area is 29 inches, mostly rainfall in the late spring and summer months. Rainfall fluctuates greatly between years and droughts are common. Experimental pastures are on stony soils of limestone origin. Typically, the woody overstory is composed of a liveoak *(Quercus virginiana)* - shinoak *(Quercus breviloba)* savannah aspect in which regrowth ashe juniper *(Juniperus ashei)* shrubs are conspicious. Texas wintergrass *(Stipa leucotricha)*, curly mesquite *(Hilaria belangeri)* and various three-awn species *(Aristida* spp.) comprise the more common grasses with numerous other species present in considerably lesser quantity. Most forbs are annuals; their availability being much influenced by the time and amount of rainfall.

Ten 96-acre pastures were installed, each with an 8-foot net-wire

[1] *The authors wish to recognize those most responsible for the planning of the experimental grazing program: E. A. Walker, T. A. Booker, and Leslie R. Hereford, Jr. Statistical analysis of data was performed by Dr. R. B. Davis, Texas A. and M. University. This paper is a contribution of the Pittman-Robertson Federal Aid in Wildlife Restoration program, the United States Bureau of Sports Fisheries and Wildlife, and the Texas Parks and Wildlife Department cooperating.*

[2] *McMahan, C. A. 1961. A food habit study of three classes of livestock and deer. Texas Game and Fish Commission, Austin. Project W-76-R, Job 8 Completion Report (multilithed), 156 pp.*

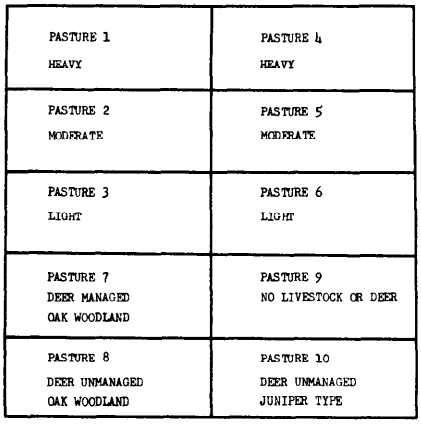

FIGURE 1. Schematic diagram of experimental pastures on the Kerr Wildlife Management Area.

fence to confine ten deer (Fig. 1). Each pasture was rectangular; pastures 1 through 3 were 3,880 feet long and 1,077 feet wide, and the remaining pastures were 5,280 feet long and 792 feet wide.

The objective of pastures 1 through 6 was to determine the influence of various domestic stocking rates on deer production. Pastures 7, 8, and 10 served as a comparison of deer productivity between two vegetative types and between two intensities of harvest. Pasture 9 was a control with no livestock or deer.

Since continuous yearlong grazing was the common management practice in the Edwards Plateau at the time the experiment was initiated, a yearlong grazing system was used in all livestock pastures, but stocking rates were varied. Heavy, moderate, and light stocking rates were begun in paired pastures. Rambouillet sheep, Angora goats, and Hereford cows were grazed in combination, in as nearly the same proportions between different stocking rates as possible. Heavily stocked pastures, each contained 23 sheep, 22 goats, and 3 cows; moderately stocked pastures, 10 sheep, 10 goats, and 2 cows; and lightly stocked pastures 8 sheep, 7 goats, and 1 cow. Heavy stocking was defined as an animal unit [3] to 8 acres; moderate as an animal unit to 16 acres; and light as an animal unit to 24 acres. The beginning number of ten deer per livestock-stocked pasture was to have been constant, but it varied some from the start of the study due to unexpected death losses. In 1961, the program was modified. Pastures 4, 5, and 6 were discontinued as replicates of the continuous grazing system and combined as a three-pasture deferred-rotation unit.

The pastures stocked with deer only have furnished information for two comparisons. Pasture number 7 was stocked with 10 deer and the population increase was removed annually during an either sex hunt. In pasture number 8 the herd was allowed to increase "unmanaged" with only occasional buck deer being harvested. Pasture 10 was designed to operate identically to pasture 8 but under different vegetative conditions. Pasture 10 was typified by an ashe juniper aspect and pasture 8 was an open oak woodland.

Herbaceous vegetation response to treatment in all pastures was measured by the line intercept method (Canfield 1941). Ten 50-foot line transects per pasture were read annually during the summer.

Browse composition was obtained by two 10-foot-wide belts running the length of each pasture. Woody species were recorded by the square feet of canopy. Condition and trend of woody species was a descriptive measure of available browse (that below 5 feet). Since the size and growth form of individual browse plants within a species group was the same, an inference can be made about comparative volumes between treatments within a species group.

To determine the monetary values associated with different stocking rates, detailed records were maintained on all expenditures and sales of livestock products. Individual weights of lambs, goat kids, wool and mohair were obtained in a manner to facilitate a statistical analysis of the data.

Findings

Influence of Grazing on Deer Production—A summary of deer production in the experimental pastures (Table 1) indicate a low carrying capacity for deer in all the livestock-stocked, continuously grazed pastures. Even in the lightly grazed pasture the average number of deer surviving was only one to 24 acres. Deer production — defined as fawns surviving to yearling age —decreased with an increase in the domestic stocking rate. This is especially evident in the heavily grazed pastures where no fawns have ever survived to yearling age. The difference in the average number of deer surviving (about 4 adult deer) between moderate and light grazing is small; but the heavily grazed pasture supported only about half as many adult deer as the moderate or light.

In contrast to poor deer production in the livestock-stocked pastures, the deer-only, managed population showed a good measure of success. No fawn production data in terms of a doe to fawn ratio are available because of the difficulty in differentiating between sexes, but pasture 7 averaged an annual 37 percent herd increment. Production in the stocked pastures on the other hand was well below this. No production was obtained under

Table 1. Deer performance in experimental grazing pastures, averages for 8 years, 1956 to 1963.

Pasture Treatments	Starting Population	Adult Death Loss	Fawn Survival
	— — — — Number — — — —		
Heavily Stocked	4.5	2.5	0.0
Moderately Stocked	5.7	1.5	1.1
Lightly Stocked	5.6	1.8	1.1
Deer Only, Managed Oak Type	11.3	0.6	4.9
Deer Only, Unmanaged Oak Type	13.9	0.9	4.3
Deer Only, Unmanaged Juniper Type	7.3	2.0	1.7

[3] *One animal unit was considered equivalent to 1 cow, 5 sheep, or 5 goats, deer not considered. Female brood stock was used in all pastures.*

heavy grazing, and under moderate and light grazing an average of only 38 percent of the fawns survived. The study did not reveal differences in breeding performance of individuals between grazing intensities because deer had to be trapped and introduced into the pastures from the outside to replace death losses each year. These introductions normally came after the rut, when most does were already bred.

Deer production in pasture 10, with dense ashe-juniper and no livestock, was almost nil. By March, 1964, this pasture supported a total of only 3 deer, as compared with a total of 24 deer in pasture 8, containing oak woodland. The juniper type indirectly deters deer production by suppressing the growth of staple and preferred deer foods (Ramsey, 1963).[4] Also, ashe-juniper itself is a low-value emergency deer food. (McMahan, 1961, *op. cit.*)

Differences in the performance of deer between managed and unmanaged pastures became apparent in 1962 and 1963 when the unmanaged herd showed 19 and 4 percent increment. The managed herd had 31 and 38 percent increments respectively. During this two-year interval a total of 7 deer were found dead in the unmanaged pasture while only 2 deer died in the managed pasture. Before the last two years of study little difference was noted in deer mortality and production between the two pastures. Since the degree of forage availability became more acute during this period in the unmanaged pasture, food was considered to be the probable limiting factor.

Deer mortality in the livestocked pastures was most pronounced in the fawns. Within a given year, they were the first to die. Among adults, however, there was no discernible pattern of death losses between age classes or length of time individuals were in the enclosure. Adult bucks did better than does in the enclosures, as indicated by their lower death losses. Over the 9 year period in the heavy grazed pasture bucks showed a 50 percent death loss as compared to 58 percent for adult does. In the moderately and lightly stocked pastures the death losses in adults of both sexes decreased. Bucks showed a death loss of 9 and 11 percent respectively and does a loss of 37 percent under both treatments.

Vegetative Response to Treatment. — Range conditions were poor at the beginning of the experiment due to long heavy use. After the experiment started, conditions improved in the deer-only and control pastures; remained static to slightly improved in the moderate and light continuous-use pastures and deteriorated under heavy continuous-use. Range deterioration as evidenced by erosion was curbed under all treatments except heavy use where there are active gullies and pediceled plants everywhere.

The total amount of grass as measured by basal intercept fluctuated greatly with years. The fluctuations generally followed the trends in available moisture as measured by annual rainfall (Fig. 2). The moderately grazed pasture is representative of the combined effect of livestock and rainfall, while the control pasture is representative of the effect of rainfall in the absence of livestock use.

The reserve of grass remaining on the ground and the resulting litter varied with intensity of livestock grazing. As an example, average grass height measurements during 1963 were: Heavy, 0.9 inch; Moderate, 2.3 inch; Light, 3.2 inch.

There was little change in composition between years and between pastures under continuous livestock use (Table 2). Any changes in proportions apparent-

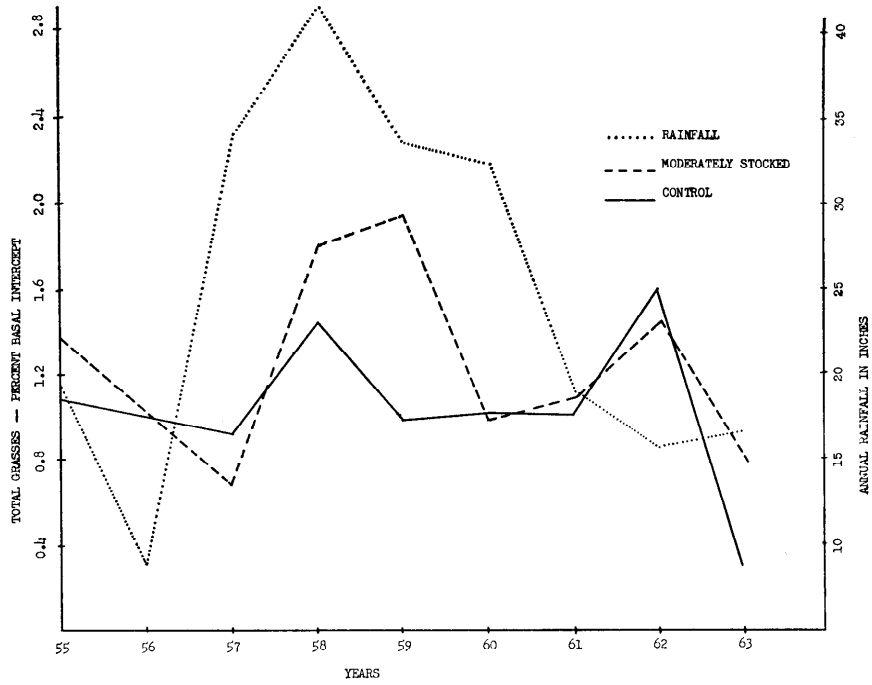

FIGURE 2. Correlation of annual rainfall and total amount of grass as measured by percent basal intercept.

[4] *Ramsey, C. W. 1963. The value of cedar in deer and livestock production on the Kerr Wildlife Management Area. Texas Parks and Wildlife Dept. Austin. Project W-76-R, Job 4 Special Report (25 pp. multilithed).*

Table 2. Basal intercept percentage of selected grass and weed species on line transects.

Species	Pasture Treatments						
	Heavy	Moderate	Light	Deer managed	Deer unmanaged	Deer unmanaged juniper	Control
Grasses							
Total	1.702[1]	1.359	1.346	1.168	1.708	.698	1.094
	.850[2]	.814	1.284	.588	.352	.224	.310
Curly	.756	.360	.240	.360	.294	.158	.290
mesquite	.292	.176	.094	.048	.026	.024	.020
Texas	.420	.470	.298	.124	.250	.060	.206
wintergrass	.484	.426	.532	.144	.122	.032	.066
Three-awn	.466	.414	.686	.524	.676	.112	.392
species	.050	.162	.456	.222	.052	.044	.082
Tall dropseed			.006			.116	.019
						.030	.034
Fall							.006
witchgrass				.036	.016		.086
Little					.008		
bluestem					.040	.010	.060
Weeds[2]							
Fleabane *(Erigeron canadensis)*							.034
Leafflower *(Phyllanthus polygonoides)*				.004			.088
Velvet bundleflower *(Desmanthus velutinus)*				.012			.020
Woollywhite *(Hymenopappus tenuifolius)*							.092

[1] 1954 readings
[2] 1963 readings

ly are more related to distribution and amount of rainfall than to animal treatment. An exception is Texas wintergrass which increased in all pastures. Perennial bunch grasses increased in the deer-only and control pastures. After an initial increase, species such as little bluestem *(Andropogon scoparius)*, tall dropseed *(Sporobolus asper)*, and fall witchgrass *(Leptoloma cognatum)* had either remained static or decreased in the deer-only and control pastures, presumably from lack of use.

Forb composition in the stocked pastures was much the same, with only a few additional species showing in the deer-only pastures. Only in the control pasture was the weed composition greatly different from those pastures containing animals (Table 2).

Woody plant composition as measured by square feet of canopy remained the same throughout the pastures containing livestock (Table 3). A few additional palatable species occur in the deer-only, oak woodland type. The only large increase in available preferred browse occurred in the control pasture. Species such as woolybucket bumelia *(Bumelia lanuginosa)*, and hackberry *(Celtis* spp.), which are highly palatable to both goats and deer were unable to reproduce or to furnish more than a token amount of forage in the livestock pastures. Staple browse species such as liveoak and shinoak remained about the same within a pasture between years, and between pastures containing livestock. Although browse composition as measured by canopy was very similar between all treatments there was a wide difference in available forage. Table 3 gives a descriptive measure of the relative availability to browsing animals of leafage below five feet. An additional measure, the presence and height of a "browse line," is indicative of the relative availability of browse. Table 4 illustrates the increase in browse in the absence of livestock as measured by browse line height.

These vegetative measurements indicate that continuous grazing provides little or no differences in plant composition regardless of the stocking rate in effect. Differences in stocking rates as reflected in range vegetation are seen mainly as quantitative ones, with few decreaser grass species, preferred forbs, or browse plants becoming established. In effect this system may be described as a vegetal complex composed of plant species that are adapted to the limiting factors of the area—the grazing animals. The main difference between this complex and the deer-only pastures is the greater abundance of staple browse in pastures 7 and 8. Apparently continuous use by deer alone may restrict forage composition to species tolerant of continuous use by those animals.

Livestock Production — Livestock production and average returns are shown in Table 5. Lamb and goat kid weights per head increased significantly with a decrease in the stocking rate.

Although wool and mohair production data indicated an increase in per head production with decrease in stocking rates, statistical values show some relationship in need of further explanation. For example significant differences are noted in wool production per head between heavy and moderate, and between heavy and light grazing, but no significant difference is evident between production in

Table 3. Composition and percentage of selected browse plants per condition and utilization class, 1963.[1]

	Species				
	Liveoak	Juniper	Shinoak	Hackberry	Bumelia
Pasture					
Heavy	8.47[2]	.54	.29	.22	Trace
	24-7				
	76-8	100-3	100-3	100-3	100-3
Moderate	8.16	2.44	1.11	.53	.03
	6-3	33-2	100-3	100-3	100-3
	69-7	58-3			
	25-8	9-5			
Light	6.62	.94	1.85	.13	Trace
	30-3	28-1	100-3	100-3	100-3
	63-7	43-2			
	7-8	29-3			
Deer, managed	9.11	5.49	2.39	.18	.12
	5-1	45-1	22-1	17-1	100-3
	70-2	5-2	78-2	44-2	
	2-3	40-4		39-3	
	10-5	10-5			
	10-7				
	3-8				
Deer, unmanaged	10.00	6.73	2.68	.14	.03
	67-2	9-1	100-3	33-1	100-3
	25-3	24-2		19-2	
	6-7	10-3		48-3	
	2-8	30-4			
		9-5			
		18-7			
Deer, unmanaged	5.48	27.00	.42	.01	.01
Juniper type	40-3	34-1	100-3	100-3	100-3
	12-5	5-2			
	8-7	3-4			
	40-8	45-7			
		13-8			
No livestock or deer	9.00	6.34	5.34	.64	.26

[1] Legend to condition and utilization classes: 1, all available light use; 2, all available, moderate use; 3, all available, heavy use; 4, mostly available, light use; 5, mostly available, moderate use; 6, mostly available, heavy use; 7, mostly unavailable; 8, unavailable.
[2] Percent composition.

Table 4. Average browse line height in inches on oaks in the experimental pastures.

Pasture treatment	Liveoak	Shinoak
Heavy	60	64
Moderate	58	62
Light	58	60
Deer, managed	None	None
Deer, unmanaged	None	58
Deer, unmanaged Juniper type	57	62

the moderate and light pastures. Mohair production on the other hand showed the opposite effect. Significant differences are seen in production per head between the moderate and light, and between the heavy and light pastures, but not between the heavy and moderate pastures. We cannot explain this occurrence.

The moderately grazed pasture averaged the most dollars per acre, while the lightly stocked pasture returned the most money per animal unit. The large expense of supplemental feeding in the heavy-use pasture during dry years was the main reason it produced less per acre than the moderately grazed pasture over the ten-year period. Net return per animal unit increased as the stocking rate decreased.

Discussion

Continuous grazing by combined classes of livestock adversely effects deer production through competition for food. Yearlong use by animals tends to remove the most palatable and some of the staple forage species, and concentrates competition between domestic animals and deer on fewer, less palatable species. This phenomenon becomes more apparent as the domestic stocking rate increases, as evidenced by a decrease in deer production from light to heavy livestock grazing.

Deer are clearly the losers in this type of direct competition for food. Even under starvation conditions they cannot be forced to utilize dry grass which will maintain domestic stock. A review of other research indicates that food supply, as influenced by grazing system, intensity of grazing, and by classes of animals grazed, governs positive or negative effects on deer. Most range food plants in our region grow and reproduce better when afforded some rest from grazing. Merrill et. al. (1957) in studies at the Agricultural Experiment Station, Sonora, Texas, found higher densities of deer on pastures grazed on a deferred rotation system with combined cattle, sheep, and goats, than on combined class continuous-use pastures.

In addition to the deleterious effects on deer, it is clear that heavy continuous grazing has profound bad effects on livestock production as well. All livestock products per animal decreased with an increase in the stocking

Table 5. Average livestock production in the experimental grazing pastures, 1955 through 1963.[1]

Item	Heavy		Moderate		Light
Sheep					
Wool	174.24		78.13		62.74
Wool per head	7.57	*	7.81		7.84
		**			
Per cent lamb crop sold	85.98		96.66		94.37
Total weight lambs	1,327		670.35		531.22
Average lamb weight	67.12	**	69.33		70.30
				***	
		**			
Goats					
Mohair	173.70		81.80		63.22
Mohair per head	7.89		8.18	**	9.03
		**			
Kid goat hair	28.96		16.23		11.19
Kid goat hair per head	1.98		2.03		1.90
Per cent kid crop sold	66.13		80.00		58.88
Total weight, kids	524.94		320.84		254.00
Average kid weight	36.06	**	40.10		43.15
				**	
		**			
Cattle					
Per cent calf crop sold	85.00		83.00		88.88
Total weight, calves	1,051.11		747.77		485.55
Average calf weight	411.30		449.00		546.25
Monetary returns					
Total net average	$154.64		$175.21		$143.46
Average net return per animal unit	$ 12.89		$ 29.20		$ 35.87

[1] Except where noted, all production is in pounds.
* Indicates significance at 80-90 per cent confidence interval.
** Indicates significance at the .05 level.
*** Indicates significance at 60-80 per cent confidence interval.

rate. The economic implications in this finding are exemplified in the heavy-grazed treatment where the least net dollar return per domestic animal unit was obtained.

The combined bad effects of heavy continuous grazing by livestock in the Edwards Plateau region are cumulative and do not become readily apparent until the organic litter cover has been materially reduced and food plant reproduction has been curtailed.

Summary

Continuous grazing by livestock adversely effects deer production through competition for food. Yearlong use by animals tends to remove the most palatable forage species and concentrates competition between domestic animals and deer on fewer, less palatable species. This competition becomes more apparent as the domestic stocking rate increases. Under these circumstances livestock are observed to be more efficient competitors for food than deer. Deer may also be adversely affected in the absence of livestock, again through decreased food supply by (1 building to populations above the range carrying capacity, with no harvest controls, and (2 being restricted to a home range exclusively within an ashe-juniper vegetative type, where other browse and ground cover is scarce.

Under the continuous use system in our region, deer mortality is most pronounced in fawns. Among adult deer, does exhibit a higher mortality rate than do bucks, with most death losses coming during the critical summer season.

Vegetative measurements show that more efficient use of the range may be obtained by running one or several clasess of livestock with deer in order to harvest the forage that deer do not utilize. Deer alone made inefficient use of the grass cover in their pastures.

No major difference was found in vegetative composition in the 3 continuous use pastures. The key grass plants in this system are Texas wintergrass, three-awn species, and curly mesquite. In the heavy-grazed pasture the volume of forage was less than in the other two lighter-stocked pastures, and the composition showed a procumbent growth form. Because of the lack of vegetative cover and protective litter, severe erosion was everywhere apparent on the heavy treatment, but was largely curbed in the two other stocked pastures. Only a few of the more desirable livestock and deer food plants were able to grow and reproduce under the continuous-use system. These findings reiterate the importance of giving plants periodic rest periods so that they may reproduce.

Livestock production per animal, and the net return per animal unit, increased as the stocking rate decreased. The moderately-grazed pasture averaged the most returns per acre, followed in sequence by the heavy and lightly grazed pastures.

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