Deer, Brush Control, and Livestock on the Texas Rolling Plains

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Highlight: *White-tailed deer (*Odocoileus virginianus*) were observed by spotlight in the Rolling Plains of Texas to determine deer use of habitats and how deer were influenced by brush control practices and grazing by livestock. Deer densities were greatest in the bottomland habitat. The sand shinnery oak habitat, the mesquite-juniper redland habitat, and the sandyland ecotone habitat supported moderate densities of deer. Influence of deer use from brush control practices varied in each habitat. Chaining bottomland habitat was detrimental to deer: the larger the area chained, the lower density of deer it contained. Herbicides had little detrimental effect and in some situations may have been beneficial. Grazing by sheep was negatively related to deer densities except in the bottomland habitat. In mesquite-juniper redlands and mimosa-erioneuron uplands, replacing sheep with cattle should increase deer populations.*

Many woody plants of low value for cattle production have increased on an estimated 82% of Texas grasslands (Smith and Rechenthin, 1964). Consequently, numerous techniques to reduce brush have been developed (Carter, 1958).

While some research (Box, 1964; Davis and Winkler, 1968; Goodrum and Reid, 1956; Reynolds, 1964) suggests that management for livestock forage that includes brush control may conflict with deer production, other workers (Blakey, 1947; Box and Powell, 1965; Bramble and Byrnes, 1967; Krefting and Hansen, 1969) report instances where brush control practices have been beneficial to deer.

In the Rolling Plains of Texas, ranch managers recognize the need to improve ranges for livestock production. They realize white-tailed deer are also an important range product. Little is known of deer habitat preference and the influence from brush control and grazing practices in this area, therefore, our research objectives were: (1) to obtain quantitative data on habitat use by white-tailed deer during all seasons, (2) to determine how existing brush control practices influence deer use of habitats, and (3) to evaluate the impact of class of livestock on habitat use by deer.

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Manuscript received June 10, 1974.

Methods

The ranch chosen for a study area was approximately 200 square miles in size, located in the Texas Rolling Plains as described by Thomas (1969). Habitat use by white-tailed deer was determined by making spotlight counts on transects that were each approximately 20 miles in length. Three transects, or 60 miles of line, were run during each sampling period the first year and another transect was added during the second year, increasing the total length of sample lines to 80 miles. Each transect was sampled twice each season for 2 years. The seasons of the year were considered to be three-month periods with June, July, and August the summer season, September, October, and November as fall, and so forth.

Spotlight observations were standardized according to recommendations suggested by Progulske and Duerre (1964), i.e., spotlighting was restricted to a 4-hour period, beginning 1 hour after sunset, and nights with precipitation or bright moonlight were avoided. The spotlights were 13-volt small aircraft landing lights operated with a 12-volt truck battery. Vehicle speed was maintained at approximately 10-12 mph. Counts were made on both sides of the transect from the bed of a pick-up truck. When a deer was seen, a record was made of the transect location (to the nearest 0.1 mile) and the habitat in which it occurred. A detailed evaluation of the census method was included in Darr's thesis (1971).

Transect widths were determined by measuring the distance from the vehicle to the point where the lower half of a person walking at right angles to the transect could no longer be seen. In this area the deer are approximately of waist height. Hahn (1949) reported using a similar method for determining widths of transects, but he included a white flag placed in the hip pocket of the person walking from the line. Ten samples of

transect width were taken in each of the seven habitat types. Stratifying the transects into habitat types and determining visibility in each type should meet the criteria for this type of strip census (Robinette et al., 1974).

Additional information on summer use of habitat was provided by 1.5-hour observations made at sunrise or sunset at various times each summer. Observations were made from locations allowing a view of large areas.

The vegetation was described by selecting two sites for analysis in each habitat type. Brush composition, canopy cover, and heights by species were determined by measurement of brush canopy along five randomly located line transects, each 50 ft long. Ocular estimates of the canopy cover of grasses and forbs, bare ground and litter, and the understory species frequency were recorded from 10 randomly located 16-inch square quadrats. At each site, samples were replicated four times. Taxa occurring at a sample site but not occurring in a quadrat or intercepted by a transect were listed. Scientific and common plant names are from Correll and Johnston (1970) and Gould (1969).

Few areas on the ranch had not been treated to reduce woody vegetation. Previous brush control treatments were recorded wherever they occurred so that their effect upon deer density could be determined. Areas sprayed in 1966 or earlier were assumed to have recovered brush density to the point where treatments effects could not be neasured and these were combined and used as controls. Livestock grazing practices were also recorded.

Statistical analyses ($P = 0.05$) were made using paired comparisons with t test and one-way analysis of variance with Duncan's new multiple range test (Steel and Torrie, 1960).

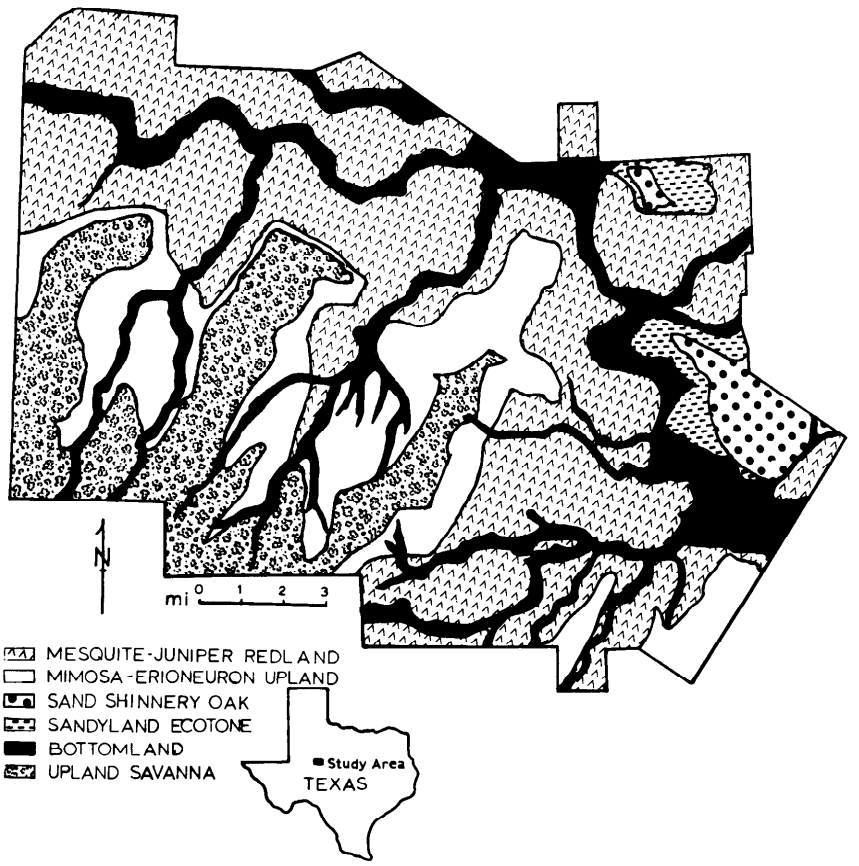

Fig. 1. *Distribution of habitats on the Renderbrook-Spade Ranch, located in the Rolling Plains of Texas.*

Study Area

The study area was within the Renderbrook-Spade Ranch, located 20 miles south of Colorado City in west-central Texas. The topography was nearly level to undulating, but with steep slopes in areas of short, rough breaks along the Colorado River and the tributaries that dissected the area.

The semiarid climate was characterized by low rainfall that occurred as sporadic and intense thundershowers, high evaporation, and extremes in temperature. Average annual precipitation has been 19.79 inches with an average daily maximum temperature in summer of 97°F (Stoner et al., 1969).

The soils in the area ranged from silty clay loam on the uplands to heavy clays in the bottomlands. Eolian sands had been deposited near and east of the Colorado River. Diversity in soils has led to a diverse vegetation.

Herbicide sprays were first used on the ranch in 1940 to reduce the density of brush. Since then, chaining and cabling were used in addition to herbicides. The principal herbicide used on the ranch was 2,4,5-T (2,4,5-trichlorophenoxyacetic acid).

Major habitats included bottomland (13%), mesquite-juniper redlands (42%), sand shinnery oak (4%), sandyland ecotone (4%), mimosa-erioneuron upland (18%), and upland savanna (19%) (Fig. 1). Chained areas in the bottomland were treated as a separate habitat for vegetative analysis and all habitats are described in Table 1.

Results and Discussion

Habitat Use

The unchained bottomland habitat contained the highest density of deer on the ranch (Table 2). Density here was four or fives times greater than in the poorest habitats—the mimosa-erioneuron upland and the upland savanna. In the bottomland habitat the shrub canopy cover was quite diverse (Table 1) and this may have been attractive to the deer. Also, this habitat was widely distributed in a dendritic pattern that interspersed with many other habitats (Fig. 1). It was available for use by most deer on the ranch.

Deer densities ranked second in the sand shinnery oak habitat despite low vegetation that provided little concealment for deer. Use is possibly related to the importance of oak browse and acorns for food items. Many authors (Hahn, 1945; Duvendeck, 1962; Segelquist and Green, 1968; Segelquist et al., 1969; Short et al., 1969) reported their significance. On this same ranch in 1968, 24 rumen samples were collected during November and December and sand shinnery oak ranked third in the diet, providing 11% of the total volume of food items (Klebenow, 1969).

Table 1. Descriptions of the major habitats on the Renderbrook-Spade Ranch, Texas.

Habitat		Vegetative characteristics	Dominant brush species	Canopy cover (%)
Bottomland Unchained	Flat river and stream terraces and alluvial fans, sometimes hummocky with frequent gullies and sinkholes. Water table high, occasionally forming pools in dry stream beds	Canopy cover shrubs 20%, grasses 31%, forbs 17%. Contained tree species such as little walnut (*Juglans microcarpa*) and netleaf hackberry (*Celtis reticulata*).	Desert sumac (*Rhus microphylla*)	6
			Agarito (*Berberis trifoliata*)	3
			Netleaf hackberry	2
			One-seeded juniper (*Juniperus monosperma*)	2
			Lotebush (*Ziziphus ebtusfolia*	2
Chained		Canopy cover shrubs 4%, grasses 30%, forbs 16%. All regrowth less than 3 ft height.	Honey mesquite (*Prosopis glandulosa*) var. *glandulosa*	2
Mesquite-juniper redland	Soils clayer in texture and reddish in color. Located above the alluvial bottom lands. Slope varies greatly usually gentle near bottomlands, becoming steeper in upland areas. Sometimes steeper than 50 degrees. Some sites eroded, denuded of vegetation and topsoil, exposing layers of shale and interbedded clay.	Canopy cover shrubs 19%, grasses 17%, forbs 9%.	One-seeded juniper	9
			Honey mesquite	6
Sand shinnery oak	Soil deep Tivoli fine sand. Topography undulating to gently sloping. Occasional dunes.	Canopy cover shrubs 8%, grasses 18%, forbs 14%. Sand shinnery oak (*Quercus havardii*) less than 18 inches height broken by occasional motts of shin oak.	Sand shinnery oak	7
Sandyland ecotone	Soil Brownfield fine sand usually about 26 inches deep over a subsoil of red to yellow-red clay loam. Borders the sand shinnery oak habitat.	Canopy cover shrubs 8%, grasses 13%, forbs 13%. Contained a gradient of species between the sand shinnery oak habitat and the mesquite-juniper redland habitat.	Honey mesquite	6
			One-seeded juniper	1
			Catclaw (*Acacia greggii*)	1
Mimosa-erioneuron upland	Steep to gently sloping breaks. Adjacent to and lower in elevation to the upland savanna. The slopes contain rounded fragments and concretions of caliche abundant on the surface. Water erosion is a hazard as vegetation is sparse.	Canopy cover shrubs 4%, grasses 25%, forbs 10%. Most shrubs (50%) less than 3 ft height.	Catlaw mimosa (*Mimosa biuncifera*)	2
			Agarito	1
Upland savanna	Smooth, nearly level upland plains, approximately 200 ft above the Colorado River bottomland.	Canopy cover shrubs 3%, grasses 35%, forbs 10%. Contained dense growth of tobosa grass (*Hilaria mutica*) and low growing honey mesquite (3-6 ft).	Honey mesquite	3

Daytime observations in the sand shinnery oak habitat indicated few deer were present. Occasionally they could be flushed from dense oak motts and the presence of abundant deer fecal matter and bedding sites in motts indicated motts were important for cover. Visual observations at sunrise found the deer moving into the oak motts or the more dense brushy areas in adjacent habitats. The presence of oak motts and the proximity of adjacent habitats with adequate cover were probably major factors that favored deer use of the sand shinnery oak habitat type.

The mesquite-juniper redland habitat only supported about half as many deer per 100 acres as the bottomland and sand shinnery oak types. Although total brush canopy cover was similar to the bottomland habitat, there was less diversity in shrubby vegetation and forb cover was less dense. We assume these habitat features partially explain the lower number of deer found in this habitat.

The sandyland ecotone habitat also contained a moderate density of deer. However, this habitat may be more important than was indicated by spotlight sampling. The sandyland ecotone bordered the sand shinnery oak habitat and provided important daytime cover for deer. Deer were observed to move from the sand shinnery oak type into this habitat at dawn. The number of deer flushed while working in this habitat type during daylight hours suggested our spotlight samples contained a bias. Work in other habitat types did not lead to a similar suspicion.

The low numbers of deer consistently observed in the

Table 2. Density of white-tailed deer in the major habitats on the Renderbrook-Spade Ranch, June 1969-June 1971.

Habitat[1]	Deer/100 acres of habitat
Upland savanna	3[x]
Mimosa-erioneuron upland	4[x]
Sandyland ecotone	6[y]
Mesquite-juniper redland	7[y]
Sand shinnery oak	14
Unchained bottomland	17

[1] All habitats except the sand shinnery oak were sprayed in 1966 or earlier and grazed by cattle. The sand shinnery oak habitat was sprayed in 1969.

[xy]Values with similar letters are not significantly different ($P < 0.05$).

mimosa-erioneuron and upland savanna habitat types are attributed to lack of cover and food. Deer use of both these habitats appeared to be greater where they were interspersed with other habitats.

Brush Control vs Deer Density

Brush control by chaining affected the number of deer an area contained (Table 3). In the bottomlands the lowest densities of deer were in the chained areas. These areas lacked cover and deer were observed moving to and from the chained areas in the evening and early mornings. They retreated to non-chained adjacent habitats for the day just as they did in the study reported by Davis and Winkler (1968). When moving to and from or within chained areas, deer utilized any concealment available, mainly clumps of woody vegetation or drainageways in the area. These travel lanes were used by deer although several hundred yards of travel could have been eliminated by a more direct route. Few deer ventured far into chained areas where little or no cover existed and most deer tended to remain near the edge. The width of a chained area had a marked influence on the deer. Large chained bottoms approximately 2 miles wide had 3 deer/100 acres while those 1 mile wide had 11 deer/100 acres. Davis and Winkler (1968) found few deer crossing the middle of rootplowed areas.

The effects of brush control with herbicides upon deer densities were obscure. When sprayed areas were compared to a control grazed with the same class of livestock in the bottomlands, there were lower densities on the sprayed but not all differences were significant (Table 3). Results in the mesquite-juniper redland were variable with both the highest and lowest densities occurring the habitats that had been sprayed. In the sandyland ecotone the deer were nearly four times more abundant on the sprayed area than on the control. In the mimosa-erioneuron upland and upland savanna no significant differences occurred in sprayed habitats versus the controls when class of stock was considered.

Inspection of brush in aerially sprayed habitats indicated that herbicides reduced canopy cover only by top-killing honey mesquite. The root systems generally remained alive and resprouting occurred. The resprouted mesquite, plus many dead stems and branches, and other vegetative growth appeared to provide satisfactory cover for white-tailed deer.

In the mesquite-juniper redland, the stand sprayed in 1969 and grazed by cattle had a very low deer density. This stand was a narrow strip approximately 80 yards wide between cultivated land and the sand shinnery oak habitat. Spotlight sampling indicated that deer frequented these adjoining sites at night, although few deer were observed on these open areas during daylight hours. We suspect white-tailed deer were utilizing the mesquite-juniper redland areas during the day for the cover it provided but frequented the more preferred feeding areas at night.

Livestock vs Deer Density

Conflicting results were obtained when deer densities in bottomlands grazed by sheep versus those grazed by cattle were compared to the mesquite-juniper redland and mimosa-erioneuron habitats. The deer numbers were greater on sheep-grazed bottomlands. With one exception, deer densities were lower on sheep-grazed mesquite-juniper redlands and mimosa-erioneuron upland habitats than when these habitats were grazed by cattle. The exception was the area in the mesquite-juniper redland that we discussed above and believe was nearly vacated by deer at night when the deer moved to adjacent feeding areas.

The mesquite-juniper redland, mimosa-erioneuron upland, and bottomland habitat grazed by sheep were all located in the same pastures. We suspect that competition from sheep in the mesquite-juniper redland and mimosa-erioneuron upland habitats forced deer into the most favorable deer habitat in the pastures, the bottomland habitat. The cause appeared to be forage depletion in the poorer redland and upland areas while the bottomlands were still producing adequate forage for deer and sheep. Competition for forage between deer and livestock becomes much more intense during drouths (Merrill, 1957) and precipitation in 1970 (12.5 inches) was well below the annual average of 19.79 inches. McMahan (1964) reported that white-tailed deer feeding habits closely resembled those of sheep and that they compete for forage. He noted that white-tailed deer tended to abandon pastures stocked with sheep. While the Renderbrook-Spade deer did not abandon the pastures, they appeared to retreat to the more productive bottomland habitat even though sheep also utilized those areas.

Table 3. Density (number/100 acres) of white-tailed deer in the major habitats on the Renderbrook-Spade Ranch as affected by brush control and livestock grazing, June 1969-June 1971.

Treatment	Bottomland	Mesquite-juniper redland	Sandyland ecotone	Mimosa-erioneuron upland	Upland savanna
Control[1] /Cattle	17[xy]	7	6	4[x]	3[x]
Control[1] /Sheep	23	4		1[y]	2[x]
1967 Chain/Cattle	8[z]				
1970 Chain/Cattle	10[z]				
1968 Spray/Cattle	14[y]	13		4[x]	3[x]
1968 Spray/Sheep					4[x]
1969 Spray/Cattle		0.3[x]	22		
1970 Spray/Sheep	19[x]	2[x]		1[y]	1[x]

[1] Treatments designated as controls were sprayed in 1966 or earlier.

[xyz]Values with similar letters within each column are not significantly different ($P < 0.05$).

Conclusions

Brush control should be coupled with deer management on a habitat

basis. The bottomlands and sand shinnery oak habitats had the highest densities of deer on the ranch and any brush control program in these areas should be carefully considered. White-tailed deer densities in the mesquite-juniper redland habitat were moderate, but considerations for deer are important especially since the mesquite-juniper redland habitat was the predominate habitat on the ranch and thus contained a considerable number of deer. Brush management in the mimosa-erioneuron upland and upland savanna habitats would not be of great significance to deer since these habitats received minor white-tailed deer use.

Chaining removed canopy vegetation that provided cover for white-tailed deer, and deer densities were less on chained bottomlands. Deer used chained areas but the densities declined with distance from adequate cover. Chaining would be most compatible if smaller areas were treated and strips and clumps of woody vegetation were left to provide travel lanes and escape cover for deer.

Aerial spraying of herbicides should be coordinated with white-tailed deer habitat improvement in the mesquite-juniper redlands, the sandy ecotone, and the bottomlands. Herbicides presently being used gave effective kills only on top growth of honey mesquite. The dead tops and regrowth from the roots still provided cover for the deer. This effect could change, however, if development and use of more effective herbicides or persistent use of present herbicides should eventually remove the brush. The results could be the same as chaining.

Oak motts in the sand shinnery oak habitat should not be removed because they are critical for deer use of this habitat. Brushy areas in habitats adjacent to the sand shinnery oak habitat should also be left for cover.

The kind of livestock can have a marked effect on deer use of a habitat. Since grazing by sheep appeared to be detrimental to deer, the relative values of one resource versus the other should be considered. Pastures grazed by sheep in the mesquite-juniper redlands and mimosa-erioneuron uplands had lower deer densities than those grazed by cattle. Since these habitats occupy approximately 65% of the ranch, sheep numbers should be manipulated according to the desired population level of deer.

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