Grazing Management Impacts on Quail During Drought in the Northern Rio Grande Plain, Texas

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Abstract

Relationships between the abundance of 2 quail species and range site and grazing management during drought were evaluated in the northern Rio Grande Plain of Texas. Clay loam range sites provided better nesting cover and greater abundance of forbs for quail than sandy loam and shallow ridge range sites. Foliar cover and aboveground standing crop of grass were greater on the 3 range sites within the short duration and deferred rotation systems as compared with the yearlong system. During drought, grazing systems provided better nesting and protective cover for quail than yearlong grazing.

Recent grazing studies have shown that the primary values of grazing systems are increased forage production and range improvement (Heady 1961, Mathis et al. 1974, Kothmann 1975, Pieper et al. 1978). Many questions remain concerning effects of specialized grazing systems on wildlife populations.

Wildlife has always been a primary product of rangeland, and in recent years the economic value of game animals has become increasingly important to landowners in Texas. A growing interest in quail among Texas hunters points to the desirability of understanding effects of grazing management on quail populations. The objective of this study was to evaluate bobwhite *(Colinus virginianus)* and scaled *(Callipepla squamata)* quail indices of abundance in relation to vegetation parameters affected by grazing management and range site.

Study Area

The study was conducted from March through December 1980 on the Rio Grande Plain Experimental Ranch. The 4,228-ha ranch, located about 55 km west-southwest of Uvalde, Texas, is operated by the Texas Agricultural Experiment Station.

The area has a subtropical steppe climate characterized by mild winters and hot summers. The average annual rainfall is about 50 cm, and periodic droughts are common. Over a 75-year period, 53% of the annual rainfall has been below average with 1 of 4 years having less than 40 cm (Waldrip 1957). The frost-free period lasts about 285 days. Mean air temperatures range from -4° C in January to 42° C in July.

Total rainfall for 1980 was 48 cm, with major storms in May (18 cm), August (11 cm) and November (7 cm), contributing 75% of the annual total. Only about 4 cm of precipitation fell during January through April, so spring vegetative growth and most quail breeding activity were delayed until after the May rainfall. Above average temperatures were recorded during June and July, with total rainfall during this period of only 2 cm. Rainfall received in August and November as a result of hurricanes relieved drought effects on vegetation.

The topography of the ranch is flat to gently sloping. Soils are clays (Entic Pellusterts), clay loams (Aridic Haplustolls, Aridic Calciustolls), sandy loams (Aridic Paleustalfs, Ustollic Calciorthids), and shallow gravelly loams (Petrocalcic Calciustolls, Ustollic Paleorthids). Located in the South Texas Plains Vegetational Area (Gould 1975), the ranch is typical of the mixed brush country of south Texas.

Methods

The grazing systems were initiated in 1975 and include a 6-pasture, 1-herd short duration system, a 4-pasture, 3-herd deferred rotation system, and a 1-pasture, 1-herd yearlong system (Fig. 1). Pastures 9 and 11 of the short duration system, pasture 10 of the deferred rotation system, and pasture 12, grazed yearlong, comprised the study areas. These pastures were chosen because they included mixtures of the various range sites in somewhat equal proportions.

All grazing systems were stocked with Hereford × Brahman, Angus × Brahman, and Santa Gertrudis cows. The cattle under yearlong grazing were drylot fed from March 23–May 24 because of lack of forage and critical weight loss by animals due to drought.

The average 1980 yearlong stocking rates were 7.2, 9.0, and 9.4 ha/AU for the short duration, deferred rotation, and yearlong grazing systems, respectively. Actual stocking rates for each study pasture are shown in Figure 1. The short duration system was stocked 25% heavier than the other 2 systems. Of pastures used in the study, pasture 11 of the short duration system had the highest stocking rate during 1980. Stocking densities (AU/ha during the grazing period) were greater for short duration pastures and least for the pasture grazed yearlong.

Clay loam, sandy loam, and shallow ridge range sites were sampled within each pasture in which they occurred. Thirty-four transects, each 150 m in length, were located randomly on each range site in each pasture. Ten, 0.25-m^2 plots, randomly located along each transect, were used to sample herbaceous vegetation in March, May, August, and December. Foliar cover was estimated for grass species using a gridded sampling frame with adjustable legs. A measure of forb abundance was determined by recording the number of 10-cm^2 grid areas, within the 0.25 m^2 frame, in which each forb species occurred. Current standing crop of grasses and forbs was clipped at ground level for each plot and weighed in the field during each sampling period. Samples of clipped vegetation were oven dried to determine moisture content and dry weight of field samples.

Three methods were used to index quail abundance. Visual counts from horseback were made from May through December. Two permanent transects, each about 1.6 km long, were established in each of pastures 9, 10, and 11, and 4 transects were placed in pasture 12. Transects were located across the 3 range sites in each pasture as equally as possible (Table 1). The transects were ridden monthly during morning and afternoon. Quail sightings were

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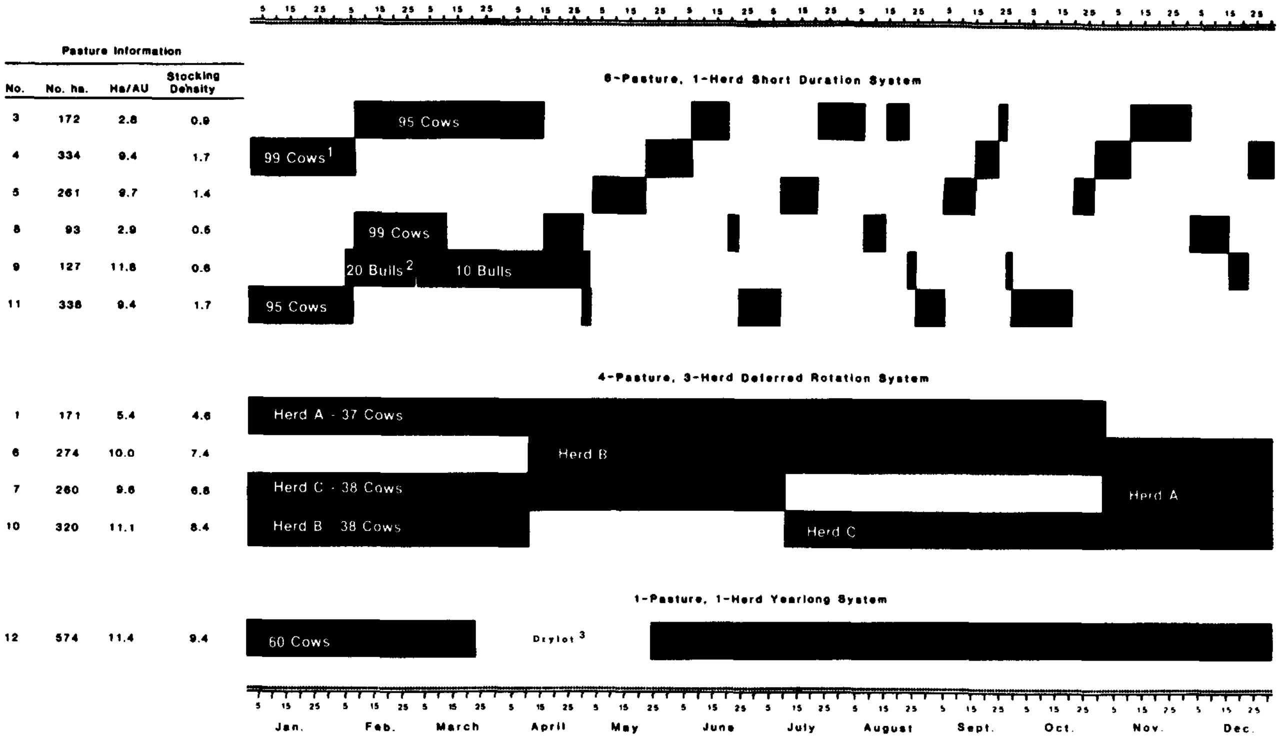

recorded by species, site, and pasture. Whistling cocks heard along horseback transects from May through July also were recorded.

Roadside whistle counts were conducted on 2 consecutive days every 2 weeks from May through July. Quail seen along the road during whistle counts were recorded as well. Visual roadside counts were made during the morning and afternoon of 2 consecutive days every 2 weeks from August through December. Both whistle and visual counts were made along a 16.1 km route through the study area. In addition, birds have been counted monthly from a vehicle along a 32 km route since 1976 (Table 2).

Indices of quail abundance were developed using the number of birds recorded for each method. These indices were used in correlation analysis with vegetation parameters. The indices are expressed as follows:

$$\text{Horseback Index: } \frac{\text{Total no. of birds observed}}{\text{Total distance covered (km)}} \rightarrow \frac{\Sigma \text{ of no counts}}{n \times \text{transect length}}$$

$$\text{Whistle Index: } \frac{\text{Total no of birds heard}}{\text{Total no. of stops}} \rightarrow \frac{\Sigma \text{ of no counts}}{n \times 10 \text{ stops/count}}$$

$$\text{Roadside Index: } \frac{\text{Total no. of birds observed}}{\text{Total distance covered (km)}} \rightarrow \frac{\Sigma \text{ of n (roadside + whistle) counts}}{\text{n} \times \text{total distance covered along route during roadside and whistle counts}}$$

The Chi-Square Goodness-of-fit test was used to determine if quail were observed more frequently than expected in each pasture and range site. To determine which cell of the Chi-Square test was contributing to significance a set of simultaneous confidence intervals was established (Neu et al. 1974) with Bonferroni *t*-statistic

Table 1. Transect length (horseback) located in each site and pasture.

Pasture and grazing system[1]	Ha	Range site	Ha	Distance in each site (km)	Total distance (km)
9 (SD)	127	Clay loam	42	1.51	
		Shallow ridge	77	1.68	3.19
10 (DR)	320	Clay loam	157	1.06	
		Sandy loam	96	1.43	
		Shallow ridge	67	0.73	3.22
11 (SD)	338	Clay loam	223	1.61	
		Sandy loam	112	1.38	
		Shallow ridge	3	0.26	3.25
12 (Y)	574	Clay loam	333	2.72	
		Sandy loam	201	2.99	
		Shallow ridge	40	0.82	6.53

[1]SD-Short Duration, DR-Deferred Rotation, Y-Yearlong.

Table 2. Average number of quail/32 km seen on monthly counts from a vehicle on the Rio Grande Plain Experimental Ranch from 1976 through 1980.

Year	Bobwhite Quail	Scaled Quail
1976	18	4
1977	52	9
1978	15	2
1979	19	5
1980	3	1

approximated (Miller 1981, p. 70).

Results and Discussion

Quail populations were low throughout the study period due to drought conditions beginning in 1979 and continuing through April 1980.

Foliar cover of grasses was significantly greater on clay loam sites compared to sandy loam and shallow ridge sites during each sampling period and over all sampling dates in each of the 4 pastures (Table 3). Clay loam sites in pastures 9 of the short duration system and 10 of the deferred rotation system had greater grass cover than the same range site in pasture 12, grazed yearlong.

Aboveground standing crop of grass was significantly greater on clay loam sites compared to sandy loam and shallow ridge sites during each sampling period and over all dates in each of the pastures (Table 3). Short duration pasture 9 had greater grass weights on clay loam sites compared to other pastures. Trends showed that pasture 12, grazed yearlong, had the lowest grass weights on each of the 3 range sites. Pasture 9 had the lowest stocking rate at 11.8 ha/AU and short duration pasture 11 the highest at 9.4 ha/AU.

Forb abundance was generally higher on clay loam sites, although there were few significant differences (Table 3). Forbs were most abundant on clay loam sites in pasture 12 of the yearlong system.

Although Chi-Square analysis showed that bobwhite use of at least one of the pastures was significantly different than expected ($\alpha < .025$), use of Bonferroni *t*-statistic showed that quail occurred in each pasture with expected frequency (Table 4). Scaled quail

Table 3. Differences in grass cover, weights and forb abundance for range sites by dates and pastures.

Range site	Date[1] March	May	Aug.	Dec.	Pasture[2] 9 SD	10 DR	11 SD	12 Y	Avg.
				Grass cover (m²/ha) × 10⁻²					
Clay loam	2.6^{a}	3.5^{a}	4.4^{a}	3.4^{a}	3.9^{a}	4.2^{a}	3.3^{ab}	2.7^{b}	3.5^{a}
Sandy loam	1.0^{b}	1.0^{b}	1.3^{b}	1.1^{b}	—	1.1^{c}	1.4^{c}	0.7^{c}	1.1^{b}
Shallow ridge	0.7^{b}	0.7^{b}	1.0^{b}	0.7^{b}	1.2^{c}	0.8^{c}	0.7^{c}	0.4^{c}	0.8^{b}
				Grass weights (g/m²)					
Clay loam	24.0^{a}	39.2^{a}	77.2^{a}	50.1^{a}	72.6^{a}	45.7^{b}	41.8^{b}	32.7^{b}	48.2^{a}
Sandy loam	9.3^{b}	10.2^{b}	19.0^{b}	14.0^{b}	—	15.7^{c}	13.2^{c}	10.1^{c}	13.0^{b}
Shallow ridge	8.7^{b}	4.9^{b}	9.7^{b}	8.1^{b}	10.1^{c}	8.0^{c}	7.3^{c}	5.3^{c}	7.7^{b}
				Forb Abundance[3]					
Clay loam	6.5^{a}	10.2^{a}	12.5^{a}	27.7^{a}	10.2^{bcd}	15.7^{ab}	14.8^{abc}	16.7^{a}	14.3^{a}
Sandy loam	3.7^{a}	8.6^{a}	9.6^{b}	22.9^{b}	—	11.0^{bcd}	8.6^{d}	13.3^{abcd}	11.0^{a}
Shallow ridge	5.6^{a}	7.3^{a}	7.7^{b}	20.6^{b}	9.4^{cd}	9.9^{cd}	11.2^{abcd}	10.7^{bcd}	10.3^{a}

[1]Data are compared by column. Means followed by the same letter do not differ significantly at the 5% level by Duncan's new multiple range test.
[2]Means followed by the same letter do not differ significantly at the 5% level by Duncan's new multiple range test. SD-Short Duration, DR-Deferred Rotation, Y-Yearlong.
[3]Average number of 10cm² grid areas in which forb species occurred (based on 10, 0.25m² plots/transect or 250 grid areas).

Table 4. Occurrence of quail in each pasture on the 1359 ha study area from May through December 1980.

Species	Pasture and grazing system	Proportion of[a] total transect length (Pi_o)	Number of quail observed	Expected number[b] of quail observed	Proportion observed in each pasture (Pi)	Confidence interval on[c] proportion of occurrence (95% family confidence coefficient)
Bobwhite	9 (SD)	.197	14	23	.118	$0 \leq P_1 \leq .236$
	10 (DR)	.199	29	24	.244	$.086 \leq P_2 \leq .402$
	11 (SD)	.201	17	24	.143	$.014 \leq P_3 \leq .272$
	12 (Y)	.403	59	48	.496	$.312 \leq P_4 \leq .680$
Total		1.00	119	119		
Scaled	9	.197	33	10	.623	$.356 \leq P_1 \leq .890$
	10	.199	8	11	.151	$0 \leq P_2 \leq .348$
	11	.201	4	11	.075	$0 \leq P_3 \leq .220$
	12	.403	8	21	.151	$0 \leq P_4 \leq .348$
Total		1.00	53	53		

[a]Proportions of total transect length represent expected quail observation values as if quail occurred in each pasture in exact proportion to availability.
[b]Calculated by multiplying proportion $Pi_o \times n$; i.e., $.430 \times 119 = 48$.
[c]Pi represents theoretical proportion of occurrence and is compared to corresponding Pi_o to determine if hypothesis of proportional use is accepted or rejected, i.e., $Pi = Pi_o$.

Table 5. Occurrence of quail on each range site on the 1359 ha study area from May through December 1980.

Species	Range site	Proportion of[a] total transect length (Pi_o)	Number of quail observed	Expected number[b] of quail observed	Proportion observed in each range site (Pi)	Confidence interval on[c] proportion of occurrence (95% family confidence coefficient)
Bobwhite	Clay loam	.426	96	51	.807	$.646 \le P_1 \le .968$
	Sandy loam	.358	14	42	.118	$0 \le P_2 \le .250$
	Shallow ridge	.216	9	26	.076	$0 \le P_3 \le .184$
Total		1.00	119	119		
Scaled	Clay loam	.426	23	23	.434	$.130 \le P_1 \le .738$
	Sandy loam	.358	2	19	.038	$0 \le P_2 \le .155$
	Shallow ridge	.216	28	11	.528	$.222 \le P_3 \le .834$
Total		1.00	53	53		

[a]P [illegible] nsect length represent expected quail observation values as if quail occurred in each range site in exact proportion to availability.
[b][illegible] ing proportion $Pi_o \times n$; i.e., $.216 \times 119 = 26$.
[c][illegible] proportion of occurrence and is compared to corresponding Pi_o to determine if hypothesis of proportional use is accepted or rejected, i.e., Pi [illegible] Pi_o.

were observed more frequently than expected in short duration pasture 9, i.e., expected use of pasture 9 was .197 while confidence intervals on observed use were $.356 \le Pi < .890$. Scaled quail use of pasture 12, grazed yearlong was less than expected. Pasture 9 consisted of 61% shallow ridge range site, whereas pasture 12 contained only 7% shallow ridge site.

Clay loam range sites were used significantly more frequently by bobwhite quail, while both sandy loam and shallow ridge sites were used less frequently than expected (Table 5). Scaled quail were observed on shallow ridge range sites signficantly more often than expected, whereas sandy loam sites were used less frequently. Scaled quail were observed on clay loam sites with expected frequency.

Whistle count data showed that 81% (155) of the bobwhite whistling cocks recorded in pastures 10, 11, and 12 from April through September were on clay loam sites. These sites provided the greatest perennial grass cover. Sandy loam and shallow ridge sites had 18% and 1% of the bobwhites, respectively. The importance of grass cover to nesting bobwhites has been reported by Lehmann (1946), Parmalee (1955), and Jackson (1972) in Texas. Scaled quail differed from bobwhite with 37, 49 and 14% of the calls being recorded on clay loam, sandy loam, and shallow ridge sites, respectively. In west Texas, Wallmo (1956) observed that calling scaled quail males wandered extensively from one elevated perch to another. This behavior may be reflected in this study. Although scaled quail frequently were observed on shallow ridge sites, the lack of herbaceous cover on these sites probably prevented their use as nesting habitat.

A number of significant correlations were seen between bobwhite quail indices and vegetation parameters (Table 6). Both horseback and whistle indices showed significant positive relationships between cover and weight of grasses and bobwhite abundance. Correlation coefficients were highest for the whistle index as compared with the horseback index. There were significant positive relationships between bobwhite quail and forb abundance and weight in pastures 11 (short duration) and 12 (yearlong). Forb height was also significantly related to bobwhite abundance in pasture 12 (Table 6).

Few significant correlations were found between scaled quail indices of abundance and vegetation parameters. Perhaps scaled quail were less specific in their habitat preferences under the environmental conditions of this study, and were therefore less likely to show relationships.

Conclusion

The clay loam range site was most important in providing adequate nesting and screening cover and a greater abundance of forbs for quail during the drought year of 1980. Bobwhite quail were particularly dependent upon this habitat type. The more moist clay loam sites may be analogous to bottomlands, identified by Jackson (1972) as "key" habitat for bobwhite quail in the Rolling Plains of Texas. Vegetation on both habitat types was more stable than on other sites during drought. The preference of bobwhite quail for greater herbaceous cover, provided by the clay loam site during the nesting season, was shown by whistle counts.

In southwestern Texas where periodic droughts are common, fluctuations in bobwhite populations are expected. Land managers interested in maintaining highest quail populations during drought years should consider quail habitat requirements when planning practices which affect clay loam range sites. The trend toward greater grass cover and weight within short-duration and deferred rotation pastures showed these grazing systems to be more valua-

Table 6. Correlation coefficients of bobwhite quail abundance indices and vegetation parameters.

	Horseback index				Whistle index			
	Pastures				Pastures			
Vegetation parameters	10	11	12	Total	10	11	12	Total
Grass cover	0.84*		0.78*	0.47**	0.88*	0.96**		
Grass weight	0.80*	0.74*	0.88**		0.89*	0.89*	0.87*	
Forb abundance		0.70*					0.87*	0.85**
Forb weight			0.89**				0.97**	0.70**
Forb height			0.80**				0.85*	

*Significant at $P<0.05$ level.
**Significant at $P<0.01$ level.
Correlations that were not significant are not shown.

ble than continuous grazing in providing adequate nesting and protective cover for bobwhites during a drought year. The higher abundance of forbs and lower cover and weight of grasses under yearlong grazing also indicated range deterioration compared to use of a rotational grazing system. Chamrad et al. (1982) showed 5-year average beef production and net income per hectare highest for short duration grazing and lowest for yearlong grazing. Hence, better grazing management for cattle was also best for quail production under drought conditions.

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