COMPETITION BETWEEN BOBWHITE AND SCALED QUAIL FOR HABITAT IN TEXAS[a]

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Abstract: Between 20 May and 10 June 1976, habitat surveys and bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*) whistle counts were conducted along 133 24-km randomly established transects in Texas. In 3 of 4 ecological areas of Texas where both species occurred, each species selected different habitats during the breeding season. Scaled quail selected the more dense, shorter shrub habitat, whereas bobwhites were located in the more open, taller vegetation types. In the fourth area, the High Plains, habitat use overlapped. The positive correlation of whistle counts of the 2 species, and a lack of adequate cover suggested there was direct competition for habitat during the breeding season.

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Many field studies have been conducted on the bobwhite and scaled quail; however, most have reflected only general requirements. More research has been conducted on the bobwhite than on the scaled quail. This is probably due to the greater abundance and range of the bobwhite (Robbins et al. 1966). In Texas, bobwhite is one of the most popular game birds (Jackson et al. 1966) with scaled quail hunted to a lesser degree (Wallmo and Uzzell 1958).

Quail flourished and extended their range under early agricultural practices in the United States (Wing 1951:110). As agriculture became more mechanized, quail food supply decreased and their numbers declined (Stoddard 1931, Schumacher 1969). In areas where bobwhite and scaled quail are sympatric, extensive agriculture has decreased the available habitat and may be forcing the 2 species to compete for the remaining resources.

Game biologists have used roadside counts of whistling bobwhites as an estimate of relative abundance (Bennitt 1951, Elder 1956, Rosene 1957, Norton et al. 1961). Banks (1970) and Campbell et al. (1973) utilized calling scaled quail as an indicator of relative abundance in New Mexico. Reid (1977) using the number of male bobwhite and scaled quail heard whistling as an index to relative abundance, determined that habitat parameters associated with high whistle counts could be used as a guide to habitat management for each species.

The objectives of our study were to: (1) compare habitat differences between bobwhite and scaled quail; and, (2) determine if the 2 species, where sympatric in Texas, are in competition for habitat resources.

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who collected the whistle-count data. This paper constitutes part of a thesis submitted in partial fulfillment of a Master of Science degree by the first author.

METHODS

The breeding habitat of bobwhite and scaled quail was classified and inventoried on 133 transects (Reid 1977) within the 10 ecological areas (Gould 1975) of Texas. Each call-count transect was 24 km long and was randomly established by the Texas Parks and Wildlife Department (Dunks 1975).

Quail whistle counts were obtained for each transect through the cooperation of the Texas Parks and Wildlife Department. Each transect was surveyed 3 times between 20 May and 10 June 1976. Whistle-count data were collected at 1.6 km intervals (stops) along each transect, beginning 0.5 h before sunrise and ending 1.5 h after sunrise. An audio count was made of the total number of bobwhite and scaled quail heard whistling during a 3-min period at each of 15 stops along each transect. Transect whistle counts were calculated by determining the sum of the whistle counts for each of the 15 stops. Whistle counts were not conducted if it was raining or if the wind speed was greater than 3 on the Beaufort Scale.

Habitat along the transects was also surveyed between 20 May and 10 June 1976, utilizing a method of classifying habitats from a vehicle (Grue et al. 1976). Habitat type was defined as a description of the vegetation of an area consisting of a unique combination of height, composition, and spatial distribution. An index to minimum habitat interspersion (Reid et al. 1977) and habitat diversity (Shannon 1948) were included as habitat parameters. Habitat types significantly ($P<0.05$) correlated with quail whistle counts were identified from a matrix of product-moment correlation coefficients. The "Corr" procedure of the Statistical Analysis System (Barr and Goodnight 1972) was used. Whistle count data for each of the 3 surveys conducted on the transects were included in all analyses because the variation in whistle counts between surveys was significant (Reid 1977).

Values for habitat types were defined as the sum of their linear distance (Grue et al. 1976). The proportion of each habitat type was determined by the proportion of the transect line intersecting each habitat type.

In ecological areas where both species occurred, correlation coefficients of the mean number of bobwhite and scaled quail calling along each transect was used as an index of spatial overlap of the 2 species. It was assumed that a negative correlation coefficient indicated less spatial overlap and therefore less chance for competition, whereas a positive correlation was assumed to indicate greater competition for resources.

A measure of habitat overlap within each ecological area for both quail species was determined using a modification of Cody's (1974:88) equation for determination of habitat overlap for 2 species. Habitat overlap was obtained from a ratio of the number of habitat types the 2 species held significantly in common (based on product-moment correlation coefficients for habitat types significantly correlated with quail whistle counts), p12, to the number of such habitats each species had available to it within each ecological area,

$$H,12 = p12/(p11 + p12)(p22 + p12) \text{ (after Cody 1974)}$$

where p11 and p22 were the numbers of habitat types with which each species was significantly correlated without the other so being. Correlations of different signs for each species for a single habitat type and correlations for 1 species where the habitat type was not significantly correlated with the second species comprised these latter 2 values.

RESULTS AND DISCUSSION

Bobwhite whistles were not recorded in the Trans-Pecos and scaled quail were not heard in the eastern 5 ecological areas of Texas (Table 1). The ranges of the 2 species

TABLE 1. Transect whistle counts for bobwhite (BW) and scaled (SQ) quail by ecological area.

Ecological area	Number of transects	Whistle counts per transect							
		$\bar{X}$[a]		S.D.		Low		High	
		BW	SQ	BW	SQ	BW	SQ	BW	SQ
Pineywoods	9	13	0	12.8	0.0	0	0	37	0
Gulf Prairies and Marshes	6	43	0	16.4	0.0	24	0	75	0
Post Oak Savannah	9	30	0	19.5	0.0	8	0	78	0
Blackland Prairies	10	29	0	13.2	0.0	5	0	52	0
Cross Timbers and Prairies	17	46	0	27.7	0.0	8	0	118	0
South Texas Plains	18	27	2	18.9	3.8	0	0	81	14
Edwards Plateau	18	12	5	15.6	8.3	0	0	71	32
Rolling Plains	23	38	4	20.4	7.1	0	0	95	30
High Plains	14	6	3	8.2	4.7	0	0	31	22
Trans-Pecos	9	0	10	0.0	5.0	0	0	0	19

[a]Mean rounded to nearest whole bird

appeared to overlap in the South Texas Plains, Edwards Plateau, Rolling Plains, and the High Plains. Mean transect whistle counts for scaled quail were highest within the Trans-Pecos and lowest on the South Texas Plains, while bobwhite whistle counts were highest within the Cross Timbers and Prairies and lowest on the High Plains. In the 4 ecological areas where ranges overlapped, scaled quail were more abundant in the Edwards Plateau and lowest in the South Texas Plains, whereas bobwhite whistle counts were highest on the Rolling Plains and lowest on the High Plains. Bobwhite appeared to be much more abundant than scaled quail in all ecological areas where the 2 species were sympatric. In the Trans-Pecos where scaled quail were found alone, they reached densities (whistle counts) twice as high as anywhere else; however, whistle counts were still less than one-fourth that for bobwhites in their "best" areas (i.e. Cross Timbers and Prairies and Gulf Prairies and Marshes).

South Texas Plains

On the South Texas Plains, cropland was negatively correlated with bobwhite and scaled quail densities (Table 2). Although most of this area was rangeland, there were large acreages under cultivation (Table 3). Most of the cultivated areas are found in the "Valley" where truck gardening predominated. One would expect few quail in these heavily cultivated areas. The avoidance of cultivated lands by both species is reflected in the Habitat Overlap Index for this area (Table 3).

Bobwhite whistle counts were positively correlated with several mesquite habitats and deciduous woodlands. Scaled quail whistle counts were positively correlated with shrubland, shrub savannah, and habitats containing brush. Habitat diversity was positively correlated with the presence of bobwhites. Bobwhites appeared to prefer the taller, more open vegetation types, whereas scaled quail tended to select the shorter, more dense types (Table 2). Lehmann (1946) found bobwhites on the South Texas Plains preferred rather open mesquite semi-prairie. Kiel (1976) observed no adverse effects to bobwhite populations when 85% of an area was cleared of brush. In contrast, Campbell et al. (1973) reported brush was important for scaled quail in New Mexico and brush clearing should be discouraged.

TABLE 2. Product-moment correlation coefficients for habitat types significently ($P<0.05$) correlated with bobwhite (BW) and scaled quail SQ) whistle counts by ecological area.

Habitat type	Ecological area							
	South Texas Plains		Edwards Plateau		Rolling Plains		High Plains	
	BW	SQ	BW	SQ	BW	SQ	BW	SQ
CROPLAND	-0.49	-0.33	0.28	-0.29	-0.28	ns*	ns	ns
PASTURE	ns	ns	ns	0.32	ns	-0.25	-0.48	ns
SHRUBS								
Savannah	ns	0.31	-0.33	0.47	ns	ns	ns	ns
mesquite	ns	ns			0.25	ns	0.37	ns
mixed mesquite	0.53	ns						
Parkland	ns	ns	ns	ns	ns	0.45	ns	ns
mesquite	0.28	ns			0.41	ns	0.79	ns
mixed mesquite	0.48	ns						
Shrubland	ns	0.37	ns	0.48	ns	0.48	0.84	0.57
mesquite	ns	ns	ns	ns	ns	0.46	0.69	0.78
mixed mesquite	ns	ns	-0.31	0.32				
BRUSH								
Parkland	ns	ns						
Brushland	ns	0.35	0.68	ns				
with mesquite	ns	0.39						
TREES								
Savannah								
deciduous	ns	ns	0.56	-0.40	0.40	-0.24		
conifer					ns	ns		
mesquite	0.60	ns	0.46	ns	ns	ns	0.70	ns
mixed mesquite	ns	ns	0.68	ns	0.31	ns		
Parkland								
deciduous	ns	ns	ns	-0.53	ns	ns	0.40	ns
conifer			0.28	ns	-0.32	ns		
mixed	ns	ns	ns	ns				
mesquite	0.72	ns	ns	ns	0.41	ns	0.40	ns
mixed mesquite	0.28	-0.30	0.26	-0.29	ns	ns		
Woodland								
deciduous	0.27	ns	ns	-0.35	ns	ns		
with understory	ns	ns	ns	ns	ns	ns		
without	0.28	ns	ns	-0.34	ns	ns		
conifer								
with understory								
without								

TABLE 2. (continued)

mixed	ns	ns	ns	ns				
with understory								
without			ns	-0.35				
mesquite	ns	ns	ns	nms	ns	ns	0.75	0.75
mixed mesquite	0.30	ns	0.31	-0.26	ns	ns	0.40	ns
HABITAT DIVERSITY	0.51	ns	0.34	-0.62	0.47	ns	0.44	ns
HABITAT INTERSPERSION	ns	ns	0.51	-0.58	0.33	ns	0.44	0.40

*Nonsignificant, $P>0.05$

TABLE 3. Bobwhite and scaled quail whistle-count correlations, habitat overlap index, and percent cropland by ecological area in which both species were present.

Ecological area	Whistle count correlation coefficients	Habitat overlap index	% cropland
South Texas Plains	-0.44	0.123[a]	19.27
Edwards Plateau	-0.351	0.000	0.33
Rolling Plains	0.198	0.000	33.93
High Plains	0.601*	0.577	75.63

[a]The higher the index the greater the habitat overlap.
*Significant ($P<0.05$)

Bobwhite and scaled quail whistle counts were negatively correlated with one another and their Habitat Overlap Index for this region was low (Table 3). This indicates there was little competition for habitat between the 2 species during the breeding season on the South Texas Plains.

Edwards Plateau

On the Edwards Plateau, bobwhite whistle counts were high within cropland, brushland, parkland, woodland, and savannahs, whereas scaled quail whistle counts were low within these habitats (Table 2). Scaled quail whistle counts were high within mixed mesquite shrubland and shrub savannah. Both habitat diversity and interspersion were positively correlated with bobwhite whistle counts and negatively correlated with scaled quail whistle counts. It appeared that bobwhites were selecting tall vegetation within diverse habitats while scaled quail appeared to be selecting short vegetation in dense habitats.

Bobwhite and scaled quail whistle counts were negatively correlated within the Edwards Plateau (Table 3). A Habitat Overlap Index of 0.0 also indicated no competition between bobwhite and scaled quail for nesting habitat on the Edwards Plateau.

Rolling Plains

Habitat types positively correlated with bobwhite whistle counts on the Rolling Plains included mesquite shrub savannah, mesquite shrub parkland, deciduous savannah, mixed mesquite savannah, and mesquite parkland (Table 2). Habitat diversity and

interspersion were positively correlated with bobwhite whistle counts. Scaled quail whistle counts were positively correlated with shrub parkland, shrubland, and mesquite shrubland. As on the South Texas Plains and the Edwards Plateau, bobwhite and scaled quail on the Rolling Plains appeared to select different habitats for nesting. Bobwhite selected the taller, more diverse, open habitats. Scaled quail selected the shorter shrub types with the more closed canopies.

Jackson (1969) found habitat interspersion to be an important factor for bobwhite management on the Rolling Plains. Mesquite was the most abundant and important woody cover on the Rolling Plains, but acreages were probably far greater than would be required for maintaining maximum bobwhite numbers (Jackson 1969). It is recognized that mesquite is regarded as undesirable by range managers, but its entire removal from an area will displace bobwhites (Jackson 1969).

Whistle-count correlation coefficients for bobwhite and scaled quail on the Rolling Plains were positive but not significant (Table 3). The Habitat Overlap Index indicated no overlap. Again these data suggest there was probably little or no direct competition for breeding habitat between the 2 species on the Rolling Plains.

High Plains

On the High Plains, several habitat types were significantly correlated with the abundance of both species (Table 2). Shrubland, mesquite shrubland, woodland, and habitat interspersion were positively correlated with whistle counts of both species. In addition, bobwhite whistle counts were positively correlated with other mesquite habitats, deciduous parkland, and habitat diversity. Bobwhites appeared to be selecting the taller mesquite habitats, whereas scaled quail were associated with shorter vegetation. However, there were many more similarities in the habitats selected by the 2 species than in the other ecological areas. The only other region in which there were similarities was the South Texas Plains where whistle counts of both species were negatively correlated with cropland.

In the High Plains, whistle counts for bobwhite and scaled quail were significantly correlated ($r = 0.601$) and the Habitat Overlap Index was higher than in any other region (Table 3). These data suggest there may have been direct competition for breeding habitat between the 2 species on the High Plains.

There was a significant positive correlation ($r = 0.988$) between whistle-count correlation coefficients of both species and the percent cropland within the 4 ecological areas. A significant positive correlation ($r = 0.889$) was also noted for the Habitat Overlap Index and the percent cropland within the 4 areas. Because of the large (75.63%) amount of land in cultivation in the High Plains (Table 3), the apparent competition between the 2 species may be due to the absense of adequate nesting cover. Excessive cultivation has apparently forced the 2 species to utilize jointly the remaining cover in the High Plains.

CONCLUSIONS

Bobwhite and scaled quail appeared to select different breeding habitat in 3 of the 4 ecological areas of Texas in which they both occurred. There was probably little or no direct competition between the 2 species for breeding habitat on the South Texas Plains, Edwards Plateau, or Rolling Plains. On the High Plains, the similarity of habitat types correlated with whistle counts of both species, the fact that the whistle counts of the 2 species were also significantly correlated, and the possible lack of adequate cover suggest there was direct competition for breeding habitat.

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