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NORTHERN BOBWHITE DENSITIES IN BURNED AND UNBURNED REDBERRY JUNIPER RANGELANDS

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Abstract: We estimated northern bobwhite (*Colinus virginianus*) densities in 4- and 8-year-old burned and unburned redberry juniper (*Juniperus pinchottii*) dominated pastures. The 4-year-old burned (800 ha), 8-year-old burned (1,200 ha), and unburned (1,200 ha) treatment sites had 8.6, 14.4, and 22.3% woody canopy coverage, respectively. Fall bobwhite densities were estimated from 122 flushes of quail coveys on 592.8 km of transects. Data histograms indicated that bobwhite were harder to detect in the unburned area than in the 8-year-old burn or the 4-year-old burn. Probability detection functions were smaller in the old burn than the new burn ($P = 0.05$) or unburned area ($P = 0.02$). Bobwhite densities of 43.3, 55.1, and 60.5 birds/100 ha in the 4-year-old burn, 8-year-old burn, and unburned sites, respectively, were similar ($P > 0.10$). Prescribed burning to control redberry juniper and manage bobwhite should be designed to maintain intermittent shrub coverage.

Key words: *Colinus virginianus*, densities, line transects, northern bobwhite, prescribed burning, rangeland, Texas.

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Prescribed burning is used to reduce canopy cover of redberry juniper and reduce downed (chained) woody debris on the Rolling Plains of Texas. Areas subjected to brush control burns support populations of northern bobwhite. Jackson (1969:32) hypothesized that complete brush control on the Rolling Plains would eliminate quail populations. However, prescribed burns generally do not consume all brush; furthermore, redberry juniper resprouts following fire (Steuter 1982). Although bobwhite are not likely to be eliminated from areas treated with fire, Renwald (1979) reported that quail loafing coverts were reduced following burning of honey mesquite (*Prosopis glandulosa*).

Historically, bobwhite management on the Rolling Plains was superseded by livestock management. While landowner interest is shifting away from single-goal management schemes (Jackson 1969:32), few plans exist for integrated management of quail and livestock. Our objective was to estimate fall densities of northern bobwhite in 4- and 8-year-old burned and unburned redberry juniper habitat.

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STUDY AREA

The study area was on the Masterson JY ranch in northeastern King County, Texas. Mean daily maximum temperature in summer was 35.4 C and the mean daily minimum in winter was -1.2 C (Richardson et al. 1974). Topography varied from level to steep, and average annual precipitation was 59 cm. Soils are lithic and of the Talpa series (Steuter 1982). Primary shrub species were redberry juniper, honey mesquite, lotebush (*Ziziphus obtusifolia*), skunkbush (*Rhus aromatica*), littleleaf sumac (*R. microphylla*), catclaw mimosa (*Mimosa biuncifera*), and catclaw acacia (*Acacia greggii*). Dominant grasses on the site included perennial three-awns (*Aristida* spp.), sideoats grama (*Bouteloua curtipendula*), blue grama (*B. gracilis*), buffalograss (*Buchloe dactyloides*), hairy tridens (*Erioneuron pilosum*), rough tridens (*Tridens muticus*), tobosa (*Hilaria mutica*), and Texas wintergrass (*Stipa*

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leucotricha). Common forb species were basket flower (*Centaurea americana*), fleabane (*Erigeron modestus*), spurge (*Evolvulus nuttallianus*), rabbit-tobacco (*Evax verna*), evening primrose (*Calylophus drummondianus*), bitterweed (*Hymenoxys scaposa*), white aster (*Leucelene ericoides*), flax (*Linum* sp.), plantains (*Plantago* spp.), silver-leaf nightshade (*Solanum elaeagnifolium*), scarlet globe-mallow (*Sphaeralcea coccinea*), wood sage (*Teucrium canadense*), green-thread (*Thelesperma filifolium*), Dakota vervain (*Verbena bipinnatifida*), and common broomweed (*Xanthocephalum drancunculoides*).

Three treatment sites were surveyed in fall 1986: an 800-ha pasture that was in its fourth growing season following fire treatment (new burn), a 1,200-ha pasture in its eighth growing season (old burn), and a 1,200-ha unburned control. All sites were chained in 1974 or 1975 and had similar plant associations before fire treatment (Steuter 1982). Treatment sites were burned with strip headfires in March under a prescription of 21-26 C air temperature, 25-40% relative humidity, and 12-24 km/hour wind speeds which resulted in burned coverage of 80-90%. Pastures were grazed on continuous systems at stocking rates of 1 cow-calf per 20-22 ha and received light quail hunting pressure.

METHODS

Line-intercept (Canfield 1941) was used to estimate percent live brush in each treatment. Five 100-m lines were randomly placed in each treatment and intersecting shrub lengths recorded. Potential differences in redberry juniper, mesquite, and total canopy cover were tested using analysis of variance and least-significant difference mean separation tests when the *F*-test was significant ($P < 0.05$).

In each treatment site, line-transects were established at ≥ 400 m intervals and were marked by attaching plastic flagging along fences at both ends of each line. An adequate sample of 40 observations (Burnham et al. 1980) was not obtained along initially established lines. Therefore, additional lines were established between those present and were surveyed until ≥ 40 observations were recorded in each area. Adding more lines was chosen over repeatedly walking original lines, to decrease the probability of encountering a covey already observed at the same approximate site which would bias variance estimates.

Lines were surveyed from 21 August to 31 October 1986. Each line was surveyed by an in-

dividual equipped with a compass, measuring tape, and an aerial photograph of the treatment site. Upon observing a covey, a marker was driven into the ground and the observer moved to the site of the flush. After marking the flush site, the observer returned to the marker, took the proper compass bearing, and moved along the line until perpendicular with the flush site. Right-angle distance and covey size were recorded at each observation. Transect lengths were determined by measuring lines established on aerial photographs (2 cm/km).

Covey density estimates were derived for each treatment site using program TRANSECT (Laake et al. 1979) and the Fourier series estimator (Burnham et al. 1980). Bobwhite densities were estimated by multiplying each covey density by its mean covey size, and corresponding density variances were calculated as described by Burnham et al. (1980). Potential differences in probability detection functions and bobwhite densities between treatments were tested with a *Z*-test.

RESULTS

Total canopy cover differed ($P = 0.02$) among treatment sites (Fig. 1). Redberry juniper accounted for 55, 50, and 60% of woody cover in the new burn, old burn, and unburned areas, respectively.

Histograms of perpendicular-distance distributions of bobwhite varied with treatment site (Fig. 2). Thirty-two percent of observations were within 4 m of transects in the unburned area. Only 12 and 15% of observations were within 4 m of transects in the new and old burns, respectively. Chi-square goodness-of-fit probabilities (with pooling) were 0.59, 0.38, and 0.58 in the new burn, old burn, and unburned areas, respectively; therefore the detection curve fit the data histogram.

Probability detection functions [$f(0)$], which are inversely related to covey detectability were lower for bobwhite in the old burn than in the new burn ($P = 0.05$) and unburned areas ($P = 0.02$) (Table 1). Autumn densities of northern bobwhite did not differ with treatment site ($P > 0.10$).

DISCUSSION

Although no statistical differences were detected, bobwhite densities were 40% higher in the unburned area than in the new burn (Table 1). Coefficients of variation were $< 20\%$ for all density estimates. Reduction of variation terms (which would allow more powerful comparisons of

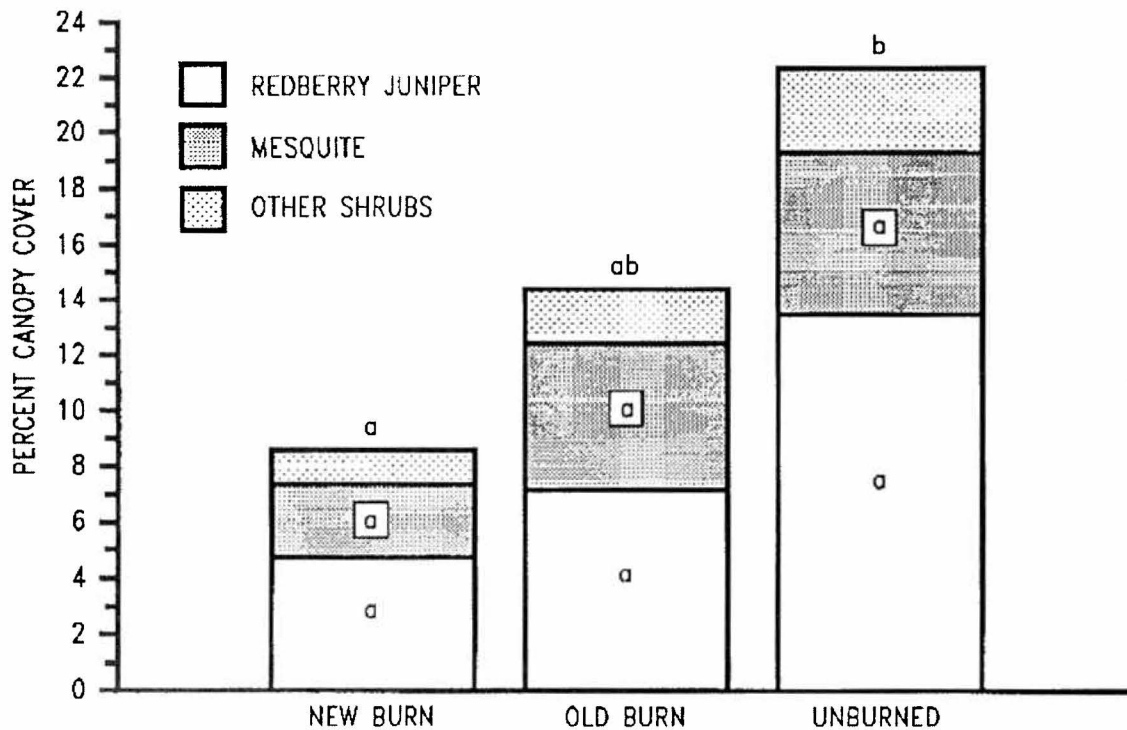


Fig. 1. Line-intercept estimates ($n = 15$) of woody canopy cover in burned (new burn = 4 years and old burn = 8 years following fire treatment) and unburned redberry juniper-dominated rangeland on the Rolling Plains of Texas, 1986. Bars and species segments denoted by the same letter were not different ($P > 0.05$).

densities) by 1/2 could have been obtained by increasing the number of observations 4 fold. However, on our study area, this could only have been accomplished with 2,400 km of transects.

Prescribed burning can be used as a bobwhite management tool. However, burns investigated in this study were large (≥ 800 ha) and were conducted under hotter (>21 C air temperature), drier ($<40\%$ relative humidity) conditions than burns aimed at improving bobwhite foraging areas (Stoddard 1931:406, Rosene 1969:301, Ellis et al. 1969, Seitz and Landers 1972, Whitehead

and McConnell 1979, Wilson and Crawford 1979). Primary objectives of prescribed burns in this study were to remove downed woody debris and decrease canopy cover of redberry juniper, thereby increasing livestock grazing potential (Steuter 1982). In the process of reducing shrub canopy cover, bobwhite loafing areas may be sacrificed in an area which is already "barely habitable" (Jackson 1969:2).

Areas having the greatest potential for bobwhite hunting have high densities of easily detected birds. Burning can improve accessibility

Table 1. Density estimates (\pm SE) of northern bobwhite (Fourier series estimator) in burned and unburned redberry juniper-dominated rangeland on the Rolling Plains of Texas, 1986.

Treatment	n	Km of lines	$f(0)^a$	Coveys/100 ha	Covey size	Birds/100 ha
New burn ^b	41	249.8	0.050 ± 0.007	4.12 ± 0.72	10.51 ± 0.81	43.3 ± 7.6
Old burn ^c	40	153.9	0.037 ± 0.003	4.75 ± 0.79	11.60 ± 0.85	55.1 ± 9.2
Unburned	41	189.1	0.057 ± 0.008	6.22 ± 0.12	9.73 ± 0.85	60.5 ± 11.8

^a Probability detection function.

^b Fourth growing season following fire treatment.

^c Eighth growing season following fire treatment.

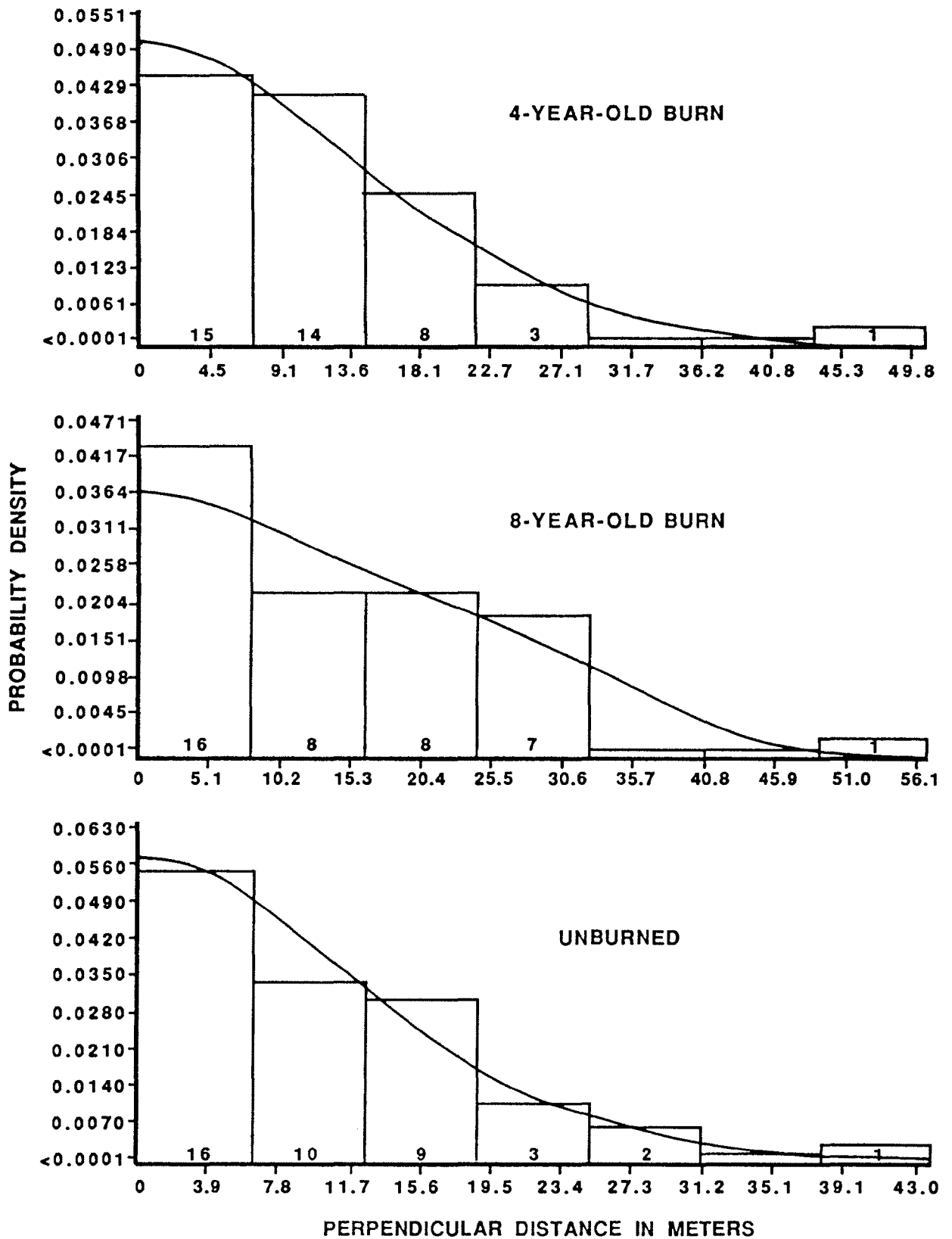


Fig. 2. Untruncated, perpendicular distance distributions and fit of the Fourier series estimator for northern bobwhite in burned and unburned redberry juniper-dominated rangeland on the Rolling Plains of Texas, 1986. Values within bars represent observations in each interval.

on previously chained redberry juniper-dominated rangelands by consuming accumulations of woody debris and reducing canopy cover of brush. However, brush control burns should be conducted under prescriptions and ignition strategies that preserve adequate shrub canopy for bobwhite. Prescribed burning of redberry juniper-dominated rangelands designed to create edges between burned and unburned brush will integrate improved livestock grazing potential with quail habitat management.

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