QUAIL RESPONSE TO TWO LARGE-SCALE WILDFIRES IN THE TEXAS PANHANDLE

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ABSTRACT

Rangeland wildfires burned 275,805 ha in 2 large blocks in the Texas Panhandle in March 2006. We assessed the impact on northern bobwhite (*Colinus virginianus*) and scaled quail (*Callipepla squamata*) populations through use of spring call-counts at 6 study sites during summer 2006–2008. Call-counts were higher in 2006 on non-burned (control) sites combined than on burned sites combined. Two years post-burn call-counts were higher on 3 of the burned sites and on 3 of the control sites. Between year comparisons revealed a difference only in the 2006/2007 pairing with 2006 having lower counts on burned than on control sites. Vegetation regrowth and concomitant quail abundance was affected more by soil texture, topography, and precipitation than spatial relation to the burn perimeter. Sites comprised of coarse-textured soils responded more quickly and likely supported higher densities pre-burn than sites with more finely-textured soils. Shortgrass sites without a significant woody component probably had lower populations pre-burn, and recovered more slowly than mid-grass communities that had a greater woody component. Landscape relief appeared to mitigate the immediate impact of the burn, enhancing recovery by providing refugia (unburned patches) within the burn.

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Key words: *Callipepla squamata*, *Colinus virginianus*, fire, northern bobwhite, scaled quail, Texas Panhandle, wildfire

INTRODUCTION

Wildfires in the High Plains ecoregion of Texas have been recognized as a frequent occurrence since early settlement (Jackson 1965, Lehmann 1984:258, Schmidly 2002:382). The topography, climate, and vegetation are conducive to large prairie fires (Jackson 1965). Weather conditions in March 2006 in the Texas Panhandle presented ideal conditions for wildfires. The region had been in a drought for 11 months, and under critical drought conditions for 5 months (Zane et al. 2006), leading the National Weather Service Storm Protection Center to issue an *Extremely Critical Fire Danger* warning for 8, 10, 11, and 12 March. Rangeland wildfires burned 294,000 ha in the Texas Panhandle during 12–18 March 2006 (J. R. Harrell, USDA-Natural Resources Conservation Service, personal communication). The largest fires, initiated by downed power lines, were the Borger Fire (143,775 ha) and the Interstate 40 (I-40) Fire (132,030 ha). Extremely low relative humidity ($<$ 10%), unseasonably warm temperatures, and sustained 74 km/hr winds with gusts of 93 km/hr pushed the fires east across the region. Fire advanced 72 km in 9 hrs at one point, spreading at a rate of 8 km/hr with flame lengths of $>$ 3 m.

Howard et al. (1959) discounted the risk of wild vertebrates dying during wildfires, but unknown numbers of various species of wildlife perished in these fires. Mortalities observed by the senior author included mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), North American porcupine (*Erethizon dorsatum*), northern raccoon (*Procyon lotor*), and quail (unknown spp.).

Quail populations, especially northern bobwhites, can benefit from prescribed fire (Stoddard 1931:413, Rosene 1969:63, Wilson and Crawford 1979, Lehmann 1984:258, Guthery 2000:71, Dabbert et al. 2007). Roseberry and Klimstra (1984:128) reported accidental fires on their Illinois study site prolonged the usefulness of nesting habitat in the face of natural succession in old fields. Jackson (1965:257) observed the impact of an "accidental grassfire" on quail in the High Plains and summarized that "prescribed burning might well be used to set plant succession back to provide habitat." Management strat-

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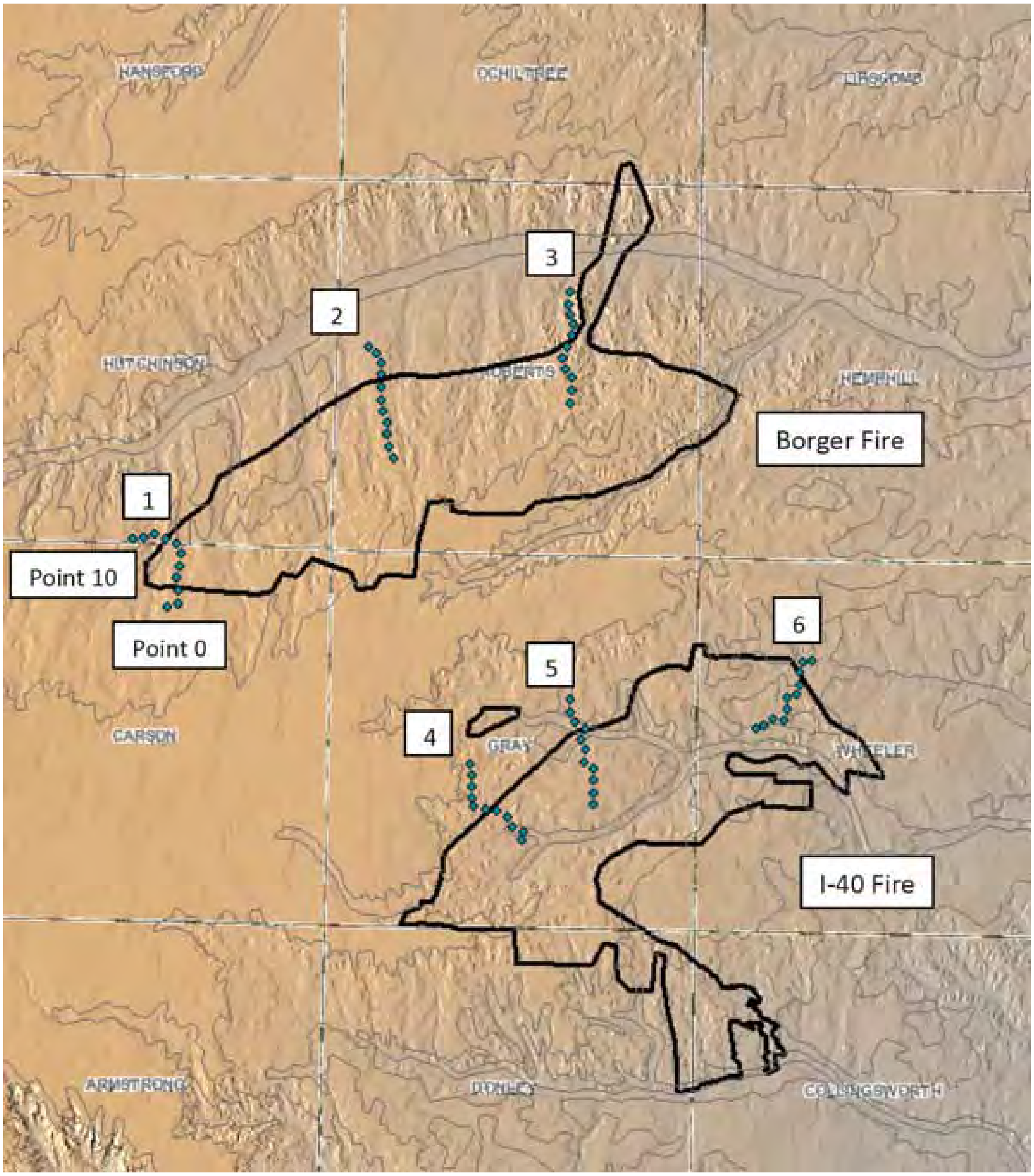

Fig. 1. Burn areas showing relief and corresponding distinct generalized vegetation communities, transect locations, and listening-point numbering scheme, northeast Texas Panhandle, 2006.

egies (including prescribed fire) that alter composition and structure of the plant community at the landscape scale increase useable space and may be effective in lessening winter quail mortality (Seckinger et al. 2008). Quail populations benefit most by burning in areas with > 75 cm average annual precipitation (Guthery 1986:75). Guthery (2000:71) contended that burning has limited applicability in more arid areas, but may be useful if applied infrequently.

Little is known about the effect of large-scale wildfires on quail populations. We initiated a study after the 2006 wildfires to assess their impact on short-term abundance of northern bobwhite and scaled quail. Our objective was to ascertain recovery rates of bobwhite and scaled quail, i.e., how quickly they became re-established at distances > 5 km from the perimeter of the wildfire-burned areas.

STUDY AREA

The Texas High Plains is a 8 million-ha subunit of the Great Plains. The region is a relatively high plateau fringed on the east and south by the Caprock Escarpment

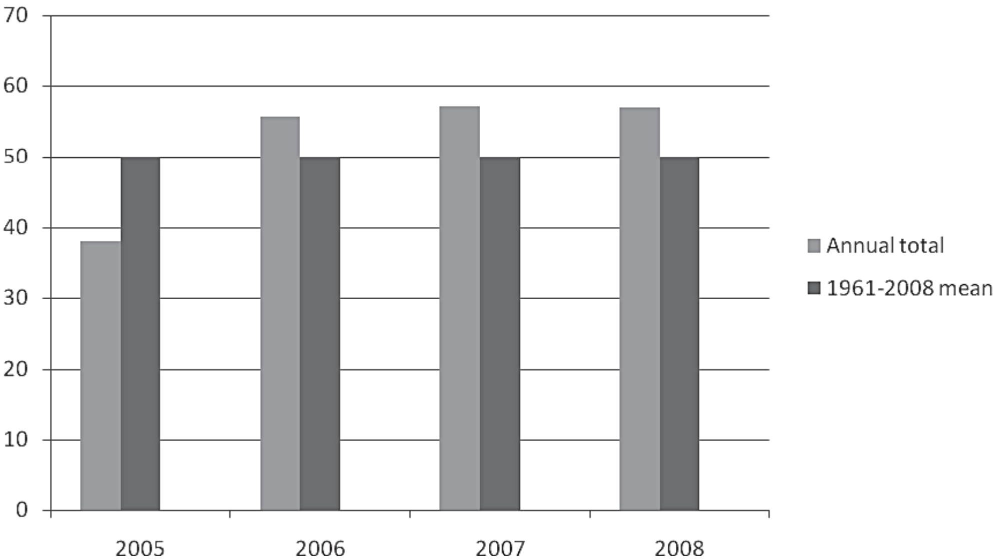

Fig. 2. Annual precipitation totals (cm) and long-term mean for Amarillo, Texas (U.S. Department of Commerce 2009).

with elevations of 915 to 1,375 m sloping gradually to the southeast (Gould 1975:13).

We established 6 study sites in Carson, Gray, Huthinson, Roberts, and Wheeler counties (Fig. 1) on private ranches in the wildfire-affected areas. The study area included portions of the High Plains (shortgrass prairie) and Rolling Plains (mid-grass-shrub) ecoregions. Annual precipitation for the region (recorded at Amarillo, Texas) was 38.1, 55.6, 57.1, and 57.0 cm for 2005, 2006, 2007, and 2008, respectively (U.S. Department of Commerce 2009) (Fig. 2). Soils ranged from fine sand to clay loam (USDA 2009). We chose study sites on the edge of burned blocks to accommodate sampling that incorporated both burned and non-burned areas.

Relative abundance of bobwhites was near the long-term mean for the High Plains and Rolling Plains ecoregions during the term of our study (Fig. 3).

METHODS

We established 3, 16-km sampling transects with listening points marked at 1.6-km intervals on each of the wildfire blocks (Fig. 1). Transects were oriented north-south, straddled the burned-non-burned interface with a minimum of 3 points inside and 3 outside the burned area, and were divided equally between the Borger and I-40 fires. Listening points were numbered 0–10, south to north.

We conducted spring cock call-counts during the peak breeding season (May–early Jul) 2006-08. Counts were initiated 30 min before official sunrise and continued for 2 hrs with 5 min actively listening at each point. Total number of calls heard and number of individual calling males heard were recorded for each listening point. Three counts were made at each point, each on different days spread over a 30-day counting period.

We used single factor ANOVA to test for differences in call counts at an *alpha* level of 0.05. We centered an 81-ha area of interest on each listening point and used soil survey data (USDA 2009) to characterize soils into broad categories, i.e., sand, loam, clay, and combinations as appropriate.

RESULTS

We heard scaled quail calling very infrequently during the study and did not include those data for this study. Bobwhite call-count data (Table 1) comprise the primary subject for analysis.

Call-count data from the Borger (Transects 1–3) and I-40 (Transects 4–6) burns by year and combined revealed a significant difference ($P \leq 0.05$) between counts on burned versus non-burned (control) sites in 2006 (Table 2). Call counts were higher on 2 of the control sites (transects 2 and 3) and lower on 1 (transect 6) 1 year post-burn. Call counts were higher on 3 of the burned sites (transects 1, 4, and 6) and on 3 of the control sites (transects 2, 3, and 5) 2 years post-burn. Between-year comparisons had a difference only in the 2006/2007 pairing with 2006 having lower call numbers on burned than on control sites.

The Borger burn versus control by-year comparison showed more quail calls on the control sites all 3 years on 2 transects. Only transect 1 in year 3 had higher numbers of calls on the burned sites. Fewer calling males were observed in 2006 at the burned listening points than at the control points. Between-year comparisons showed higher numbers in 2007 than 2008 on control sites on transect 1. More quail were heard in 2008 than either 2006 or 2007 on the burned sites on transect 3. Data by transect with all 3 years combined revealed higher numbers on control sites on transects 2 and 3.

Burned versus control listening-point data by-year comparisons for the I-40 block revealed fewer calling males on burned areas the year of the burn. Only 1 transect had higher numbers on burned sites 1 year post-

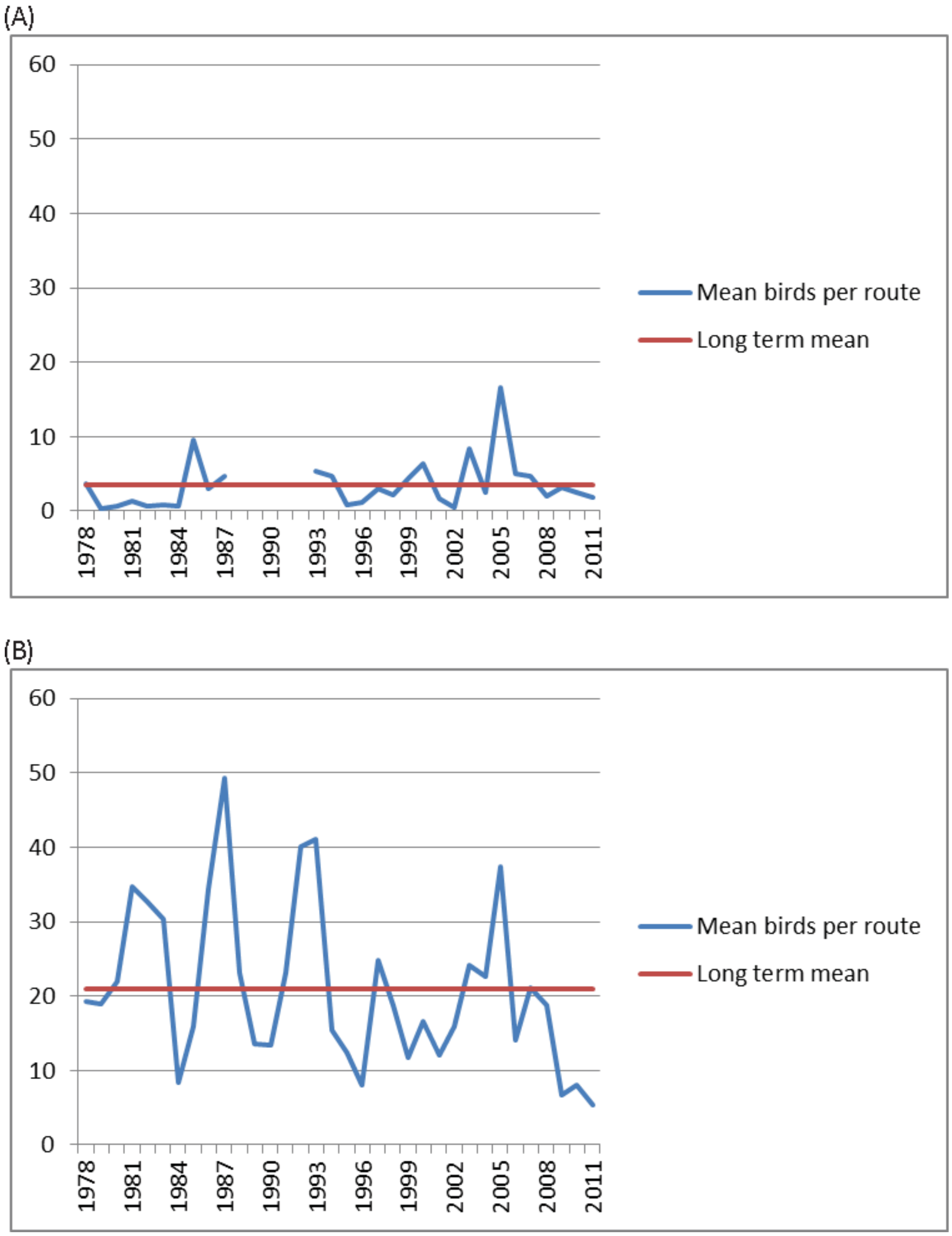

Fig. 3. Northern bobwhite abundance from 1978 to 2011 for the High Plains (A) and Rolling Plains (B) ecoregions as estimated by summer roadside counts (TPWD 2012).

burn. Two transects had more quail on the burned sites 2 years post-burn and 1 transect had higher numbers on the control sites (Table 2).

Three of the 6 individual transects had quail numbers on the burned areas less than or equal to those on the control areas for each of the 3 years post-burn. Four of the 6 transects in 2006 had significantly ($P \leq 0.05$) fewer calling males on the burned than on the control listening points (Table 2). Call counts varied according to soil texture (Table 3). Coarse-textured (i.e., sandier) sites (e.g., transect 6) responded more quickly than sites dominated by finer-textured soils (i.e., loams, clay-loams).

DISCUSSION

The impact of wildfire on birds has been studied to some extent (Jackson 1965), but the effect of shortgrass prairie wildfire on northern bobwhites is poorly understood. Wildfires are not planned (by definition), and pre-burn estimates of bobwhite abundance specific to the burned areas are unknown.

Shortgrass prairie (High Plains) portions of transects without a significant woody component would be expected to have lower bobwhite populations pre-burn than midgrass/shrub (Rolling Plains) transects possessing a significant woody component (TPWD 2012). Shortgrass

Table 1. Mean number of spring calls by bobwhite by transect (1–6), listening point (0–10), and year. Bold indicate listening points within the burned areas.

	Borger Fire									I-40 Fire								
	1			2			3			4			5			6		
	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008	2006	2007	2008
0	2.33	4.33	0.33	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.33**	**5.33**	**5.33**	**0.00**	**1.67**	**0.33**	**3.33**	**12.33**	**11.00**
1	0.00	0.67	0.00	**0.00**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**2.67**	**3.67**	**3.67**	**0.33**	**3.00**	**1.33**	**3.67**	**12.33**	**11.33**
2	0.67	1.67	0.00	**1.00**	**1.33**	**0.67**	**0.00**	**0.00**	**0.00**	**1.67**	**2.00**	**2.00**	**0.33**	**6.67**	**3.33**	**3.33**	**8.00**	**14.67**
3	**0.33**	**0.67**	**0.33**	**1.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**1.67**	**1.67**	**0.33**	**3.00**	**3.67**	**5.33**	**7.00**	**10.67**
4	**7.00**	**1.33**	**1.33**	**0.33**	**3.00**	**0.33**	**0.00**	**0.00**	**0.33**	**0.00**	**1.33**	**1.33**	**0.00**	**3.67**	**6.00**	**4.67**	**10.67**	**13.67**
5	**3.33**	**3.00**	**1.67**	**1.67**	**0.33**	**1.33**	**0.00**	**0.00**	**0.67**	0.00	2.33	0.00	**0.67**	**3.00**	**7.67**	**3.67**	**9.33**	**12.33**
6	**2.67**	**2.33**	**2.00**	**1.00**	**3.67**	**3.67**	1.67	0.00	1.33	2.33	3.67	1.00	**2.33**	**5.33**	**8.33**	**4.00**	**3.33**	**9.33**
7	3.33	4.33	0.33	3.33	4.33	3.67	1.33	2.33	4.33	1.33	1.67	1.00	4.00	5.00	5.00	**5.67**	**6.67**	**8.00**
8	4.00	4.00	0.00	3.67	2.67	4.00	2.67	2.00	6.00	0.33	1.67	0.00	4.33	4.00	7.67	5.33	6.33	8.33
9	3.67	7.67	0.00	6.00	6.67	8.00	4.67	2.67	8.00	2.67	1.33	0.67	5.67	5.00	7.67	4.00	6.00	4.67
10	0.33	0.67	0.00	5.67	8.00	6.33	4.33	2.67	7.00	3.33	3.00	0.00	5.00	4.67	5.67	4.33	4.33	4.67

sites (mostly those on more western sites in our study) had little or no recovery during the period of study. Rough, broken topography (e.g., draws, riparian areas), which typically had more shrubs (e.g., skunkbush [*Rhus trilobata*]), appeared to mitigate the immediate impact of the burn at some sites, speeding recovery by providing refugia (non-burned patches) within the burn.

Shortgrass prairie (High Plains) plant communities are inherently less habitable by northern bobwhites than midgrass/shrub communities. Soils are predominately clay loams. Woody cover is sparse with yucca (*Yucca* spp.) providing virtually the only woody cover. The primary herbaceous species are buffalograss (*Buchloe dactyloides*) and blue grama (*Bouteloua gracilis*), neither of which provides substantial nesting or escape cover for bobwhites.

Scarcity of shrubs suitable for escape and loafing cover limits use of shortgrass sites (Dabbert et al. 2007). Species like lotebush (*Ziziphus obtusifolia*) provide desirable cover for northern bobwhite and scaled quail (Rollins 2007), but are top-killed by intense fires and can take >10 years to attain sufficient size to be used as cover again (Renwald et al. 1978). Thus, woody cover recovers more slowly on shortgrass sites.

Mid-grass (Rolling Plains) sites generally have a greater woody component that is largely resilient to the effects of fire and re-sprouts rapidly and profusely (e.g., skunkbush, sand shinnery oak [*Quercus havardii*]) (Holechek et al. 2004:514). The sandy soils on these sites provide superior quail habitat (Guthery 2000:18) and regrow more rapidly post-fire, given adequate precipitation (Scifres and Hamilton 1993:80). Sand shinnery oak, primarily found on sandier soils, responds quickly by re-sprouting (Scifres and Hamilton 1993:81), providing structure and useable space for quail (Guthery 1997). These sites likely supported higher pre-burn quail numbers than clay loam sites due to differences in their respective plant communities and inherent site potential.

Substantial rainfall occurred on the eastern-most, more sandy transects within several weeks of the wildfire and likely contributed to the rapid recovery of vegetation, and subsequent bobwhite abundance (Table 2).

Rangeland wildfire is not synonymous with prescribed burning. Prescribed burning is implemented under

Table 2. Average number of spring calls by bobwhite on transects 1–6 and combined, and by year and combined, Borger (Transects 1–3) and I-40 (Transects 4–6) wildfires, Texas Panhandle, 2006–2008. Significant difference ($P \leq 0.05$) indicated by differing superscript (year) or bold (treatment).

Transect #		2006	2007	2008	2006–2008
1	Burned	3.33	1.83	**1.33**	2.00
	Not burned	1.92[a]	3.19[a]	0.89[b]	2.17
2	Burned	0.17[a]	1.33[ab]	0.86[b]	0.97
	Not burned	**4.67**	**5.42**	**5.50**	**5.19**
3	Burned	0.00[a]	0.00[a]	0.17[b]	0.55
	Not burned	**2.93**	**1.93**[a]	**5.33**[b]	**3.40**
4	Burned	1.13	2.80	**2.80**	2.24
	Not burned	1.67[ab]	2.28[a]	0.44[b]	1.46
5	Burned	0.57[a]	3.76[b]	4.38[ab]	2.90
	Not burned	**4.75**[ab]	4.67[a]	**6.50**[b]	5.30
6	Burned	4.21[a]	**8.71**[b]	**11.37**[b]	8.10
	Not burned	**4.56**	5.56	5.89	5.33
Combined	Burned	1.22[a]	2.68[b]	2.48[ab]	
	Not burned	**3.11**	3.59	3.42	

Table 3. Transects 1–3 (Borger Fire) and 4–6 (I-40 Fire) with burn status assignment and soil characterization (USDA 2009).

Point	Burn status	Two most prominent soil textures
		Transect 1
0	no	loam/gravelly loam
1	no	fine sandy loam/clay loam
2	no	clay loam/fine sandy loam
3	yes	clay loam/gravelly loam
4	yes	loam/clay loam
5	yes	loamy fine sand/fine sand
6	yes	loamy fine sand/fine sand
7	no	loamy fine sand/fine sand
8	no	stony loam/loam
9	no	gravelly loam/fine sandy loam
10	no	clay loam/fine sandy loam
		Transect 2
0	yes	loam/clay loam
1	yes	loam/clay loam
2	yes	loam/clay loam
3	yes	fine sandy loam/loam
4	yes	fine sandy loam
5	yes	fine sandy loam
6	yes	fine sandy loam/loamy fine sand
7	no	fine sandy loam/fine sand
8	no	loamy fine sand/loam
9	no	loamy fine sand/fine sand
10	no	fine sand/fine sandy loam
		Transect 3
0	yes	fine sandy loam/clay loam
1	yes	clay loam/sandy loam
2	yes	loam/clay loam
3	yes	clay loam/loam
4	yes	clay loam/fine sandy loam
5	yes	loam/fine sandy loam
6	no	fine sandy loam/gravelly loam
7	no	gravelly loam/loam
8	no	gravelly loam/fine sandy loam
9	no	fine sandy loam/gravelly loam
10	no	fine sandy loam/loam
		Transect 4
0	yes	fine sandy loam/loamy fine sand
1	yes	loamy fine sand/fine sandy loam
2	yes	fine sandy loam/clay loam
3	yes	clay loam/fine sandy loam
4	yes	loam/clay loam
5	no	loam/sandy clay loam
6	no	gravelly loam/clay loam
7	no	loam/clay loam
8	no	loam/clay loam
9	no	gravelly loam/clay loam
10	no	clay loam/gravelly loam
		Transect 5
0	yes	loamy fine sand/fine sandy loam
1	yes	fine sandy loam/loamy fine sand
2	yes	loamy fine sand
3	yes	loamy fine sand/fine sand
4	yes	loamy fine sand/fine sandy loam
5	yes	gravelly sandy loam/fine sandy loam
6	yes	loamy fine sand/gravelly sandy loam
7	no	loamy fine sand/clay loam
8	no	loamy fine sand/fine sandy loam
9	no	loamy fine sand/fine sand
10	no	loamy fine sand/fine sandy loam

Table 3. Continued.

Point	Burn status	Two most prominent soil textures
		Transect 6
0	yes	fine sandy loam/loamy fine sand
1	yes	fine sand/loamy fine sand
2	yes	fine sand
3	yes	loamy fine sand/fine sand
4	yes	loamy fine sand/fine sand
5	yes	loamy fine sand/fine sand
6	yes	loamy fine sand/fine sand
7	yes	loamy fine sand/fine sandy loam
8	no	loamy fine sand/fine sandy loam
9	no	fine sandy loam/loamy fine sand
10	no	fine sandy loam/loamy fine sand

conditions that are favorable to management objectives that may include: (1) invasive species control, (2) forage production enhancement, and (3) browse and/or forb quality improvement. Time of day, soil moisture, season, air temperature, and wind speed are among the parameters considered in planning a successful prescribed burn (Scifres and Hamilton 1993, Holechek et al. 2004). Wildfire is spontaneous, by definition unplanned, and may have few of the preferred conditions and advantages credited to prescribed burns driven by specific objectives.

MANAGEMENT IMPLICATIONS

The slow recovery of bobwhite populations in the wildfire-affected areas can likely be attributed to at least 3 factors. First, the amount and timing of post-burn rainfall produced disparate impacts within and among individual study transects. Second, soil texture and the concomitant plant response to rainfall post-burn likely contributed to the development of more habitable conditions for bobwhites on sites dominated by sandy soils. Last, recovery rates because of distance from burned edge, may have overwhelmed response of bobwhites to recolonize large landscapes, especially those devoid of woody cover.

Post-burn recovery of woody plants suitable for mid-day loafing and escape cover occurs slowly on clay-loam soils (Renwald et al 1978). Succession to a shrub overstory may take 10 years at this latitude. Extended grazing deferment, or light grazing pressure until a full growing season (or longer) has passed after substantial rainfall is received, could encourage earlier recovery post-burn.

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