NESTING OF NORTHERN BOBWHITES ON RANGELAND VERSUS CONSERVATION RESERVE PROGRAM HABITATS IN THE ROLLING PLAINS OF TEXAS

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ABSTRACT

Conservation Reserve Program (CRP) contracts account for about 1.7 million ha in Texas, and are often touted as habitat for upland game birds. We compared nest site locations, hatch rates, and arthropod abundance for northern bobwhites (*Colinus virginianus*) on CRP versus rangeland habitats at the Rolling Plains Quail Research Ranch (RPQRR), Fisher County, Texas from 2008 to 2011. Nest sites were monitored via radio-marked females. Simulated nests ($n = 144$/yr) were used to evaluate hatch rates between the 2 habitat types. Arthropod abundance (as an indicator of brood habitat) was measured annually in August using sweep nets and pitfall traps. We documented 103 nest sites, 14% were in CRP while the remaining 86% were in rangeland; bobwhites neither selected nor avoided CRP as nesting habitat. 'Survival' of simulated nests (i.e., percent intact at 28 days exposure) across the 4 years averaged 63.2% for CRP and 74.4% on rangelands. Arthropod availability was greater in rangeland in 3 of the 4 years studied. CRP pastures dominated by kleingrass (*Panicum coloratum*) were used for nesting in proportion to their availability, but rangeland provided better brood habitat.

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INTRODUCTION

The Conservation Reserve Program (CRP) has changed the agricultural landscape of the southern Great Plains since inception in 1985, nowhere more than in the High Plains and Rolling Plains ecoregions of Texas. Nationally, ~ 15 million ha were enrolled in CRP with ~ 11% of that (1.7 million ha) in Texas. The CRP was highly touted for its benefits to wildlife (especially upland birds), but expectations have not been uniformly realized across states or species groups (Best et al. 1997, Ryan et al. 1998). The population response by northern bobwhites to the CRP has varied ranging from positive (Riddle et al. 2008) to neutral (Roseberry and David 1994, Ryan et al. 1998, Riffell et al. 2008).

Several studies (Ryan et al. 1998, Riffell et al. 2008) examined the impact(s) of CRP in cropland-dominated landscapes which provide little useable space for bobwhites (e.g., southeastern U.S.), or in the intensively-cropped High Plains of Texas (Abbott et al. 2012). The landscape of the Rolling Plains tends to be rangeland (i.e., useable space for bobwhites) punctuated by agricultural fields (typically < 30 ha in size) (Rollins 2007). Thus, CRP fields are often surrounded by rangelands capable of complementing the lack of forbs and woody cover for bobwhites in CRP.

Several researchers have expressed concern about the value of some Conservation Practices (CPs) included in CRP, i.e., vegetation types used regionally, and their value as habitat for bobwhites (Berthelson et al. 1989, Best et al. 1997, Riffell et al. 2008). Introduced warm-season (CP 1) and native warm-season (CP 2) grasses dominated plantings in northwest Texas (Berthelson and Smith 1995). Native grasses typically included gramas (*Bouteloua* spp.), little bluestem (*Schizachyrium scoparium*), and switchgrass (*Panicum virgatum*).

Introduced species of grass have become a contentious issue for quail managers in South Texas (Sands 2007, Tjelmeland 2007, Moore 2010) and throughout the Midwest where tall fescue (*Schedonorus phoenix)* dominated seeding mixtures (Greenfield et al. 2002). The most commonly planted introduced grasses in the Rolling Plains were weeping lovegrass (*Eragrostis curvula*), old world bluestems (*Bothriochloa* spp.), and kleingrass (*Panicum coloratum*) (Rollins 2007).

The value of CRP for bobwhites varies relative to the age and species composition of the grass stand (Lutz et al. 1994). Initially fields are dominated by annual forbs and thin stands of grasses, and provide acceptable habitat for bobwhites, especially when these fields border brush-dominated rangelands (Lutz et al. 1994, Rollins 2007). The grass stands (often seeded as monocultures) after the first several years (depending on precipitation and soil type) crowd out forbs and decrease bare ground which is

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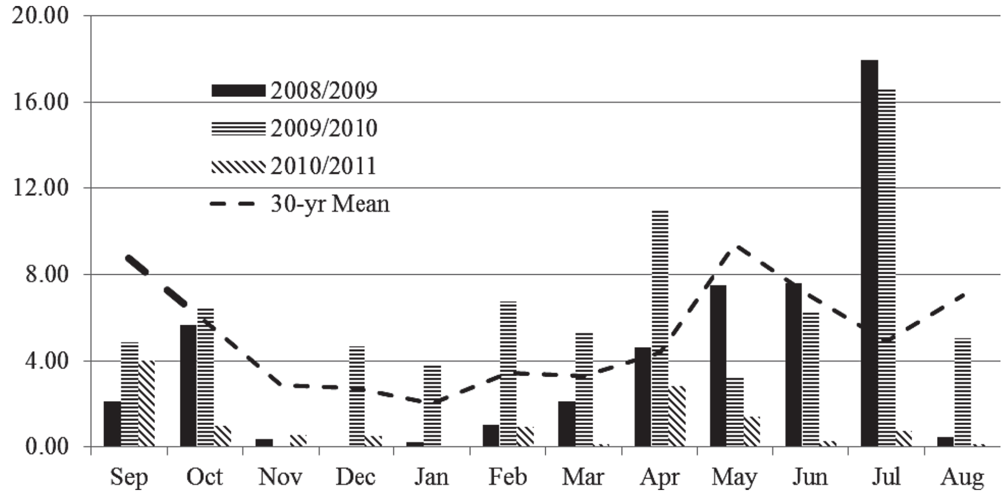

Fig. 1. Monthly precipitation (cm) on the Rolling Plains Quail Research Ranch, Fisher County, Texas, 2008-2011 versus the 30-year mean for Roby, Texas (15 km east of RPQRR).

important for bobwhite foraging and travel. Woody cover is especially limiting in CRP fields in northwest Texas. The absence of woody cover precludes use by bobwhites beyond some distance (e.g., > 50 m) from the edge of the field (Dabbert et al. 2007). Establishment and growth of suitable coverts, typically mesquite (*Prosopis glandulosa*) takes > 15 years in the Rolling Plains (Rollins 2007).

The greatest value of CRP fields for bobwhites may be for nesting cover, which is often limited on adjacent grazed rangelands (Rollins 2007). We initiated a study to document nesting of bobwhites in a landscape of CRP and rangeland typical of the Rolling Plains. Our objectives were to document nest placement and hatching rates of bobwhites in kleingrass-dominated CRP fields compared to adjacent rangelands. We also evaluated abundance of selected arthropods on the 2 vegetation types as an index to brood habitat for bobwhites.

STUDY AREA

We conducted our study on the Rolling Plains Quail Research Ranch (RPQRR), a 1,900-ha ranch 20 km west of Roby, Fisher County, Texas. The average annual precipitation is 61.5 cm with bimodal peaks in May and September. Annual precipitation varied across the years; 2008 and 2010 were above normal while 2009 and 2011 were drier than normal (Fig. 1). Exceptional drought conditions prevailed from October 2010 through September 2011, the driest 13-month period recorded in the past 136 years (Nielson-Gammon 2011).

Native range sites were on land that had only been grazed historically by cattle and not used for crop production since the 1950s. These sites were characterized by silver bluestem (*Bothriochloa saccharoides*), sideoats grama (*Bouteloua curtipendula*), and scattered colonies of old world bluestems (mostly Caucasian bluestem; *B. bladhii*). Common shrubs included mesquite, hackberry (*Celtis laevigata var. reticulata),* lotebush (*Ziziphus obtusifolia)*, catclaws (*Acacia greggii* and *Mimosa aculeaticarpa* var. *biunciferae*), and littleleaf sumac *(Rhus microphylla)*. Prickly pear (*Opuntia* spp.) cacti were abundant on rangeland sites, but largely absent on CRP. No grazing occurred from 2007 to 2011 in the pastures we used for this study. The most common soil types include Miles fine sandy loam, Woodward-Quinlan loams, and Paducah loams (USDA 2011).

Four CRP fields were included comprising 13.2% of the RPQRR's area—rangeland comprised 86.8% (Fig. 2). The sites were enrolled in the CRP in 1987–88 and consisted primarily of kleingrass with lesser amounts of silver bluestem. Regrowth mesquite occurred sporadically across the fields, but was not of sufficient size/density to constitute mid-day cover for bobwhites. The dominant soil types on CRP sites included Wichita clay loam, Weymouth clay loam, and Miles fine sandy loam (USDA 2011).

METHODS

Nesting Surveys

We trapped and radio-marked female bobwhites with neck-loop transmitters weighing ~ 6 g (American Wildlife Enterprises, Monticello, FL, USA) starting in February 2008 and continuing through August 2011. Trapping was conducted across the study area, including the juncture of CRP fields and rangeland; we assumed bobwhites had equal opportunity to select nest sites in either habitat type. We tracked birds > 2 times per week. We moved to within ~ 20 m by quietly circling the bird without flushing it when we suspected nesting. Nests were monitored every day following location until nest fate could be assigned, i.e., hatched, depredated, or abandoned. Nest locations were delineated with a handheld GPS unit and subsequently uploaded to Google Earth Software to measure distance from the edge of the CRP field in which the nest occurred.

We used simulated nests in both CRP and rangeland habitats to provide additional data on hatch rates between

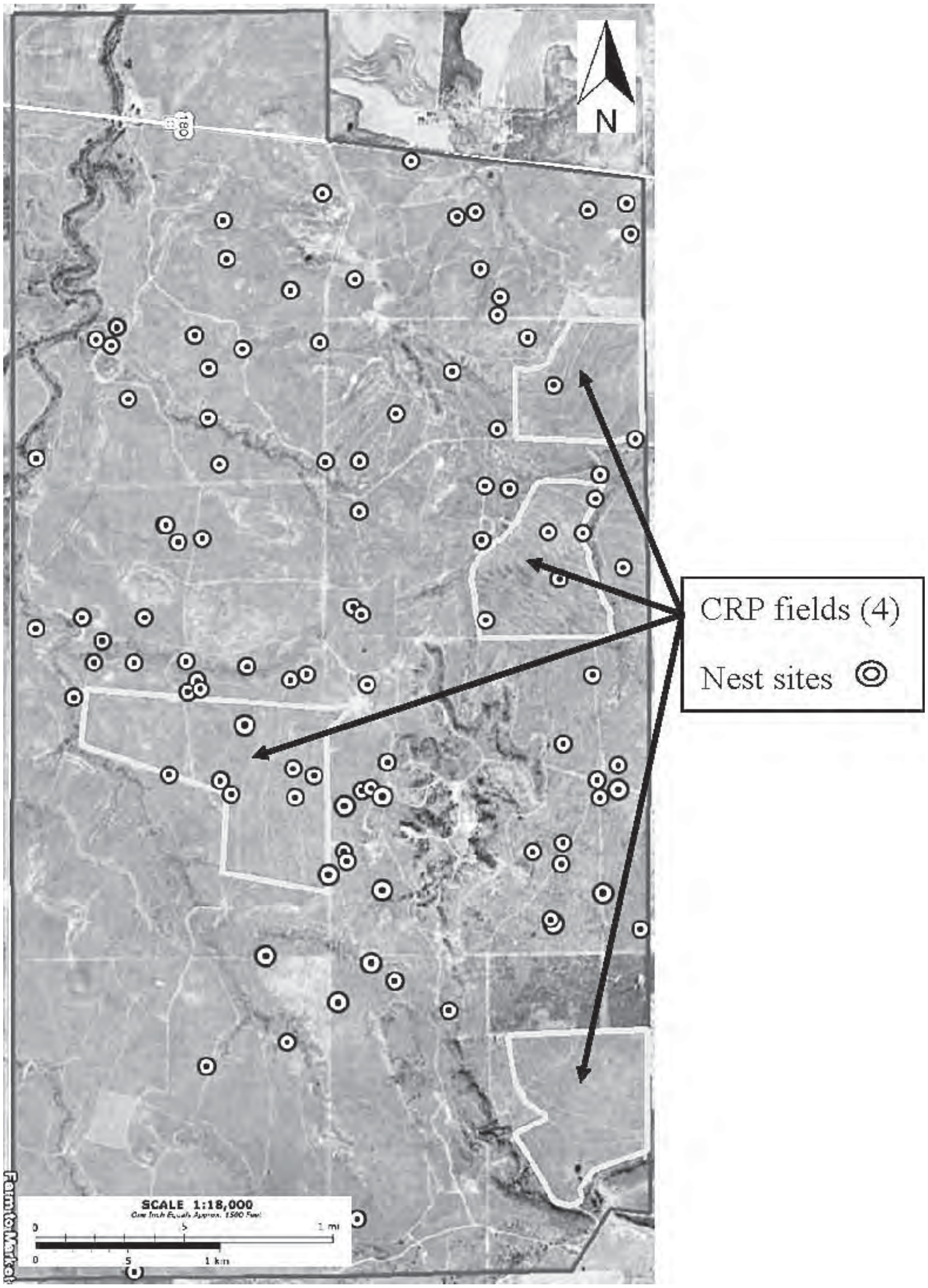

Fig. 2. Locations of Conservation Reserve Program pastures and actual bobwhite nests on the Rolling Plains Quail Research Ranch, Fisher County, Texas, 2008–2011.

the 2 vegetation types. Simulated nests have been found to reasonably depict the fate of actual bobwhite nests in the Rolling Plains (Hernández et al. 2001). We established simulated nests in June following protocols described by Slater et al. (2001) and Rollins et al. (2005), and checked them at 14- and 28-day intervals. Nests consisted of 3 unwashed medium-sized chicken eggs, and were placed at 50-m intervals along randomly-located transects; each transect consisted of 6 nests. Nests were placed alternately in suitably-sized bunchgrasses in rangeland (Lehmann 1984) or prickly pear (Slater et al. 2001). Simulated nests in CRP were placed exclusively in kleingrass. Any eggs still intact at the 14-day check were replaced with fresh eggs to minimize any olfactory cues to predators as a result of putrification.

We used 144 simulated nests each year; 12 transects (72 nests) were placed randomly in CRP (3 transects per field) and 12 were placed randomly across rangeland sites.

Table 1. Nesting locations of northern bobwhites on kleingrass (CRP) and native rangeland on the Rolling Plains Quail Research Ranch, Fisher County, Texas, 2008–2011.

	Area available		Nests recorded									
			2008		2009		2010		2011		Totals	
Vegetation	ha	%	*n*	%	*n*	%	*n*	%	*n*	%	*n*	%
CRP	216	13	6	29	3	7	3	17	1	9	13	14
Rangeland	1,633	87	21	71	41	93	18	83	10	91	90	86

Quality of nesting habitat (e.g., bunchgrass density) was estimated for (1) simulated nests by counting bunchgrasses rooted within a 2.0-m wide belt transect extending along each nest transect for simulated nests (Slater et al. 2001), and (2) for actual nests at randomly-located compass headings with the nest site as the origin along 2, 100-m transects. We calculated apparent nest success (% nests hatched) for actual nests; abandoned nests were included in these calculations and were considered depredated. We estimated hatch rate for simulated nests as the number of simulated nests intact at the 28-day check.

Arthropod Abundance

We conducted arthropod sampling in July each year (2009-2011) to assess arthropod availability. We used 2 sampling methods: sweep nets and pitfall traps. Pitfall traps consisted of plastic cups recessed into the ground so the rim of the cup was flush with the ground surface. The cup was filled ~ 1/3 full with a solution of liquid dish detergent and water. Five transects of 6 cups per transect annually were placed randomly across each of the 4 CRP fields (total of 30 cups per field). Cups were spaced 10 m apart. Pitfall traps were checked/refilled 3 and 6 days later. The soap solution was strained on collection days for arthropods with all specimens stored in paper bags, labeled, and air-dried.

Sweep-net samples consisted of 50 rapid sweeps over a distance of 30–50 m on a randomly selected heading from point of origin. A subset of the pitfall traps was selected randomly and used to ascertain which 4 of 6 pitfall cup locations would be sampled via sweep nets. Sweep-net sampling was conducted on the same day and sampled between 1200 and 1800 hrs to minimize diurnal variability. The contents were stored in paper bags after sweeping, labeled, and frozen until later analysis. We sorted arthropods by Order and counted individual specimens; only counts for the Orders Coleoptera and Orthoptera are included.

Statistical Analyses

We report only apparent nest success for actual nests. Some researchers (e.g., Mayfield 1961, Johnson 1979) suggested that estimates of apparent nest success are biased because the exact date of nest initiation is usually unknown. We assumed any bias in nest success was similar between the 2 vegetation types, and unimportant in the context of our study objectives. We used Chi-square to test whether there was a difference in the proportion of actual nests between CRP and rangeland.

RESULTS

Nesting

Bobwhites neither selected nor avoided CRP as nesting habitat ($\chi^2 = 0.09$, 1 df, $P = 0.77$). We documented 103 actual nests across the 4 years; 13 (12.6%) were in CRP pastures and 90 (87.4%) were in rangeland (Table 1, Fig. 2). Ten of 13 nests in CRP were < 100 m from the nearest edge. All 13 nests in CRP were in kleingrass, whereas most of the rangeland nests were in silver bluestem or silver bluestem-prickly pear assemblages.

Apparent nesting success tended to be lower for nests in CRP, a trend also suggested by simulated nests (Table 2). Apparent nest success pooled across the 4 years of the study averaged 38.5% ($n = 13$) compared to 52.2% for rangeland habitats ($n = 90$). Simulated nest success averaged (± SE) across all 4 years was 62.3 ± 8.0% ($n = 256$) for CRP habitats versus 74.0 ± 6.1% ($n = 256$) on rangeland. Nest success indicated by simulated nests tended to be greater than apparent nest success in both vegetation types. Available nesting clumps varied annually, but averaged (± SE) 2,682.4 ± 726.5/ha in CRP versus 2,079.4 ± 932.5/ha in rangeland. Density of grass clumps suitable for nesting was more variable across years in rangeland habitats versus CRP; this trend was especially evident in the exceptional drought year (2011) when clump density decreased to 397.2 clumps/ha.

Table 2. Fate of simulated bobwhite nests (percent intact at 28 days exposure) and actual nests in kleingrass (CRP) and native rangeland on the Rolling Plains Quail Research Ranch, Fisher County, Texas, 2008–2011; $n = 72$ simulated nests for each year in each vegetation type.

	CRP			Rangeland			
	Simulated	Actual		Simulated	Actual		
Year	(%)	*n*	Hatched	(%)	*n*	Hatched	%[a]
2008	77.8	6	4	80.6	21	12	57
2009	63.9	3	0	58.3	41	22	54
2010	63.6	3	1	86.5	18	8	44
2011	43.9	1	0	70.7	10	4	40
Mean	62.3			74.0			51

[a] Percent not included for actual nests in CRP due to small sample size ($n = 13$).

Table 3. Arthropod abundance for Orthoptera and Coleoptera on CRP (kleingrass) and rangeland sites on the Rolling Plains Quail Research Ranch, Fisher County, Texas, 2008–2011. Data for pitfall traps are mean number of individuals per transect (6 traps) and sweep nets are mean individuals per 100 sweeps. Pitfall trapping was not initiated until 2010.

	Orthoptera				Coleoptera			
	Pitfall		Sweep		Pitfall		Sweep	
Year	CRP	Rangeland	CRP	Rangeland	CRP	Rangeland	CRP	Rangeland
2008			11.5	36.3			9.3	37.1
2009			13.2	45.2			6.2	16.5
2010	7.2	5.7	48.7	18.3	12.7	32.3	10.0	1.7
2011	0.6	0.5	0.6	1.6	7.2	6.1	0.0	0.0
Mean	3.9	3.1	18.5	25.4	10.0	19.2	6.4	13.8

Arthropod Dynamics

Abundance of Orthoptera and Coleoptera varied among years (Table 3). Rangeland habitats tended to support greater arthropod abundance in most years than CRP habitats. Rangelands supported ~ 37% more orthopterans and 116% more coleopterans based on sweep-net sampling and about 92% more coleopterans based on pitfall sampling. There were 2 exceptions. The first was in 2010 (a wet year) when CRP habitats supported much higher numbers of both Orders; the second was in 2011 (exceptional drought) when arthropod availability was minimal on all sites.

DISCUSSION

Nesting

Kleingrass-dominated CRP habitats provided adequate nesting habitat for bobwhites. Bobwhites tended to nest in CRP habitats in proportion to their availability. We concur with other authors that structure of the nesting substrate seems more important than plant species involved (Lehmann 1984, Townsend et al. 2001, Moore 2010).

Rangelands in our study were not grazed, and provided excellent nesting habitat. Hatch rates observed, based on both actual and simulated nests, were well above the average reported for bobwhites across their range (mean = 28%; Rollins and Carroll 2001), and equal or above hatch rates reported for the Rolling Plains (e.g., ~ 50%; Hernández et al. 2001, Cox et al. 2005).

Nesting success tended to be lower in CRP; an observation supported by simulated nests. We believe the lack of, or at least the relative paucity of prickly pear on CRP sites may have contributed to the lower hatch rates observed in CRP relative to rangeland. Actual and simulated bobwhite nests in clumps of prickly pear survive at higher rates than those in bunchgrasses (Slater et al. 2001, Hernández et al. 2009a).

CRP sites may contribute important nesting sites for bobwhites across the Rolling Plains given that CRP sites were not grazed (except in a few exceptions) due to drought-imposed grazing availability. Rangeland sites used in this study on RPQRR were not grazed, but the majority of rangelands in the Rolling Plains were, and overgrazing is a common, and pervasive, issue in quail management in this region (Rollins 2007). Their potential for quail nesting habitat remains unclear as CRP contracts expire, depending on how these sites are managed in the future (Cearley and Kowaleski 2008).

The increasing availability of introduced grasses, and their potential for bobwhites, can be contentious issues for bobwhite managers. Several authors have cited concerns about habitat degradation as a result of introduced grasses, especially in the southwestern U.S. (Kuvlesky et al. 2002). Flanders et al. (2006) reported bobwhites were about twice as abundant on native rangelands in South Texas compared with sites dominated by introduced grasses (e.g., buffelgrass, *Pennisetum ciliare*). Clump-forming species of introduced grasses such as weeping lovegrass, buffelgrass, and guineagrass (*Urochloa maxima*) appear to provide adequate nesting habitat for bobwhites (Sands 2007, Tjelmeland 2007, Moore 2010, Abbott et al. 2012). Kleingrass is a bunchgrass with structural characteristics similar to native bunchgrasses used by bobwhites for nesting (e.g., little bluestem); other species of introduced grasses may not provide similar structure nor provide suitable nesting cover.

Many researchers have maligned introduced grasses as habitat for bobwhites, but it is also possible that presence of introduced grasses may benefit bobwhite populations by providing suitable nesting habitats during drought years or on overgrazed rangelands (Kuvlesky et al. 2002). Our data confirm that (non-grazed) kleingrass habitats maintained desirable clump density even during the most extreme drought in Texas' history. Berthelson et al. (1989) found that CRP contracts seeded with kleingrass and blue grama (*Bouteloua gracilis*) provided high quality nesting habitat for a variety of game birds in the High Plains of Texas. Our data should not be misinterpreted as an endorsement of introduced species—but an acknowledgment that some can provide suitable nesting habitat for bobwhites in the Rolling Plains.

Nest success, while adequate (i.e., > 40%) tended to be lower for nests in CRP fields than non-grazed rangeland. Slater et al. (2001) recommended a minimum of 754 prospective nest clumps/ha as a threshold of quality nesting cover for bobwhites in the Rolling Plains. Rangeland sites on the RPQRR during our study were above this threshold except during the exceptional drought of 2011; CRP sites in our study were well above the suggested threshold, even during exceptional drought. Rangeland in our study area was characterized by moderate to heavy infestations of prickly pear, and prickly pear affords nest protection from mesomammals (Slater et al. 2001, Hernández et al. 2009a).

Brood Habitat

Nesting habitat for bobwhites could be a virtue for CRP sites, but some researchers have questioned the value of introduced grass monocultures for brood-rearing, i.e., arthropod availability (Flanders et al. 2006). Orthoptera and Coleoptera were generally less available on CRP sites, but this pattern varied across years. Neither vegetation type produced many insects during exceptional drought conditions (i.e., 2011).

The CRP sites in our study typically lacked floral species diversity that would promote a more diverse, and perhaps more abundant arthropod community than that occurring on rangelands. Rangelands in typical years (2008–2009) produced greater arthropod biomass than CRP sites. CRP sites tended to produce greater arthropod abundance, especially Orthoptera in above-average precipitation years (e.g., 2010).

Most of the bobwhite nesting activity in CRP occurred near the field's edge ($<$ 100 m). None of the broods monitored used CRP to any appreciable extent. Doxon and Carroll (2007) reported CRP fields in Kansas planted to native grasses provided excellent foraging opportunities for bobwhite chicks; thus, accessibility and other issues may be more important in affecting habitat 'quality' for game bird chicks. Vegetation characteristics such as bare ground cover can impact insect availability for foraging chicks (Burger et al. 1993, Doxon and Carroll 2010). Feeding rates of bobwhite chicks were sensitive to vegetation-influenced mobility on CRP fields in western Kansas (Doxon and Carroll 2010). Management of CRP fields for bobwhite chicks can be reconciled by practices that permit more open space at ground level, such as light disking or burning, to permit easier movement.

Traditional disturbance regimes (e.g., disking) have been evaluated to enhance structure, species, composition, and mobility (i.e., access to bare ground) (Greenfield et al. 2002, Hernández et al. 2009b). Disking of rangeland can improve bobwhite habitat by increasing bare ground (Webb and Guthery 1983, Greenfield et al. 2002), stimulating growth of important food plants (Peoples et al. 1994), and creating plant structural diversity necessary for invertebrates (Manley et al. 1994). Periodic (every 2–3 years), seasonal (winter) disking should be encouraged to enhance successional plant assemblages favored by bobwhites. Other means of increasing plant species diversity (e.g., seeding legumes) have been found to increase arthropod diversity and biomass, and enhance use of CRP fields as brood habitat (Burger et al. 1993).

MANAGEMENT IMPLICATIONS

Conservation Reserve Program contracts consisting mostly of kleingrass serve adequately as nesting cover for bobwhites in the Rolling Plains of Texas. Disturbance regimes (e.g., disking, patch-grazing) may be useful to enhance species diversity and, concomitantly, arthropod diversity for managers who seek to increase their use as habitat for bobwhites once CRP contracts expire.

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