Wildlife Technical Session

Effects of Red-cockaded Woodpecker Management on Bobwhite Relative Abundance

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Abstract: Loss of pine-grassland communities has contributed to declines in populations of northern bobwhites (*Colinus virginianus;* hereafter, bobwhite) and red-cockaded woodpeckers (*Picoides borealis;* RCW). However, evolving land management priorities on publicly-owned lands managed by the U.S. Forest Service (USFS) increasingly emphasize restoration of historic cover conditions and habitat for endangered species such as the RCW. These land use changes should benefit pine-grassland species, including bobwhite, but effects are not well understood. Therefore, we monitored abundance and distribution of breeding bobwhites on the Homochitto National Forest of southwestern Mississippi during 1994–1999. We quantified abundance of breeding bobwhites using call counts in three landscapes that differed in extent of land under management for RCWs (low = 7.5%, intermediate = 46.7%, and high = 66.2%). Bobwhite abundance was closely tied to intensity of management. Landscapes with an intermediate and high proportion of stands dedicated to RCW management had relative abundance of bobwhite 46.9% and 232% greater than that observed in landscapes with a low extent of RCW management. RCW management likely enhances bobwhite habitat through maintenance of pine-grassland communities, and when applied to landscapes, has the potential to improve bobwhite populations locally and regionally.

Key words: Colinus virginianus, quail, Mississippi, northern bobwhite, pine-grassland communities, prescribed fire, RCW, red-cockaded woodpecker

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Northern bobwhite populations have been impacted by fire exclusion in pine-dominated landscapes of the southeastern United States, and have generally declined over much of their range during the last three decades of the 20th century (Brennan 1991, Sauer et al. 2004). The bobwhite is a socially, politically, and economically important species in the southeastern United States (Burger et al. 1999), yet the population decline has been particularly precipitous in this region. Although declines have been attributed to a variety of factors, the most likely cause has been large-scale deterioration of bobwhite habitat quality associated with advanced natural suc-

cession, fire suppression, intensive monoculture farming, and intensive timber management (Roseberry et al. 1979, Roseberry and Klimstra 1984, Brennan 1991).

Recently, management priorities on >800,000 ha of USFS land in the Southeast have been realigned to facilitate restoration of the federally endangered RCW and the pine-grassland ecosystem (USFS 1995). The RCW is a pyric-adapted species and many of the changes in USFS management relate to fire regimes (USFS 1995). Prescribed fire regimes intended to enhance RCW habitat quality are designed to reduce and control hardwood mid- and understory and therefore involve relatively short burning rotations (2–3 years) and greater use of growing season burns (USFS 1995, Burger et al. 1998). Although these habitat management activities may benefit bobwhites, effects of RCW habitat management on bobwhite abundance are poorly documented (Brennan et al. 1994). Therefore, our objectives were to evaluate breeding bobwhite abundance on National Forest Lands under RCW (pine-grassland restoration) and traditional management in the lower coastal plain of southwestern Mississippi. Specifically, we tested the hypothesis that relative abundance of bobwhites did not differ between three landscapes that differed in percentage of the landscape under RCW management.

Study Area

We conducted our research on the 76,378-ha Homochitto National Forest (HNF) in southwestern Mississippi. The HNF was located in the lower coastal plain physiographic region and forested stands were characterized by mixed longleaf (*Pinus palustris*), shortleaf (*P. echinata*), and loblolly pine (*P. taeda*) on xeric ridges merging into loblolly pine-hardwood on the lower slopes and mixed hardwoods in drainages. The pine component was comprised of approximately 70% loblolly, 25% shortleaf, and 5% longleaf across the entire study area. Pine stands contained no more than 29% hardwood in the main canopy (Burger et al. 1998). Mean age of mature stands was 75 years and topography was rolling to steeply broken. Bowman et al. (1999) characterized plant communities in unmanaged stands and stands managed for RCWs on HNF during our study.

From 1994–1999, we monitored breeding bobwhite populations in three areas of HNF (hereafter referred to as landscapes) that differed in extent of the landscape under RCW management. Each landscape was approximately 3,600 ha. Most (>70%) pine stands on HNF were either 1–30 or 60–80 years old due to previous timber harvest practices. Extant, mature pine stands on HNF were regeneration from these timber harvests that occurred prior to acquisition by the USFS. Pine basal area ranged from 13.8–27.6 m^2/ha with a mean of 17.2 m^2/ha. Hardwood basal areas in pine stands ranged from 2.3–4.6 m^2/ha in predominately intermediate, suppressed, and midstory stems with occasional canopy trees. Pine-hardwood stands contained 30%–50% hardwood and 50%–70% pine in the main canopy.

On HNF, traditional and RCW habitat management regimes differed primarily in hardwood midstory removal and prescribed burn frequency. During the five years preceding our study, most (>60%) stands under RCW management had undergone

one mechanical midstory removal operation, followed by prescribed fire (primarily dormant season) on a 2–3 year rotation. Stands under traditional management were prescribed burned (exclusively dormant season) on a 4–7 year rotation. For a sample of 80 stands along our routes, mean number of growing seasons since last fire and number of prescribed burns during the eight years preceding our study was 1.4 and 2.5, respectively, for stands under RCW management and 4.3 and 1, respectively, for stands under traditional management (Wood et al. 2004).

Methods

We delineated the RCW habitat management area (HMA) based on USFS (1995). We stratified sampling effort among three landscape types: 1) within the RCW HMA and with >50% of the landscape under RCW management, 2) within the RCW HMA, with <50% of the landscape under RCW management, and 3) outside the RCW HMA. Within each landscape type, we located four 7.2-km survey routes along secondary county roads and USFS roads, providing four replicates of each landscape type. Routes were separated by >800 m and considered spatially independent. Within 800 m of routes, percentage of the landscape under RCW management was 7.5% for routes outside the HMA, 46.8% inside the HMA but with <50% under active RCW management, and 66.2% inside the HMA and >50% under active RCW management. Within each route, we established 10 call count stations at 800-m intervals. During the second and third week of June 1994–1999, we surveyed each route once using bobwhite call counts. We began sampling stations 0.5 hour before sunrise and sampled until 3.5 hours after sunrise. Listeners remained at each station for 10 minutes and recorded total numbers of individual calling males heard, thereby providing an index of relative abundance of bobwhites at each station.

Because sampling points within routes were not independent, we treated routes as experimental units and summed total number of calling birds heard at the 10 points along each route as the response variable ($N = 4$ per landscape). We modeled number of calling males as a Poisson process and tested the hypothesis of no difference in bobwhite abundance among landscapes using a repeated measures analysis of variance (ANOVA) with routes as subjects and years as a repeated effect in PROC GENMOD (SAS 1992). Following a significant ($P \leq 0.05$) χ^2 test, we used least significant means (LSMEANS, SAS 1992) to compare predicted means among landscapes. Effects of fire regime and hardwood midstory removal were confounded in this design, therefore we could not attribute differences in bobwhite abundance to either fire regime or midstory removal alone. Therefore, we restricted our inferences to overall effects of RCW habitat management versus traditional management regimes within HNF. Additionally, we did not randomly assign treatments to stands, but instead, sampled landscapes under varying intensity of management from among those under existing forest service management regimes (RCW or traditional). Thus, we conducted an observational study opposed to a manipulative experiment (Eberhardt and Thomas 1991).

Table 1. Mean number of northern bobwhite males heard per 7.2 km route in three landscape contexts on Homochitto National Forest, Mississippi, 1994–1999.

	> 50% RCW[a]		< 50% RCW[a]		Outside HMA[a]	
Year	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
1994	8.75	1.11	6.25	3.09	1.75	0.85
1995	2.50	1.04	2.50	0.87	3.50	1.32
1996	6.00	1.29	1.50	0.96	2.25	0.63
1997	13.50	5.95	4.75	1.25	4.00	1.15
1998	11.00	1.78	3.00	0.71	1.75	0.86
1999	13.00	1.35	6.25	2.93	3.25	0.85
Mean	9.13	1.28	4.04	0.79	2.75	0.40

a. >50% RCW = >50% of landscape surrounding sampled route managed actively for red-cockaded woodpeckers; <50% RCW = <50% of landscape surrounding sampled route managed actively for red-cockaded woodpeckers; outside HMA = landscape contains no management for red-cockaded woodpeckers.

Results

We sampled 120 points along 12, 7.2-km routes (10 points/route) from 1994–1999. We recorded 382 bobwhites across 3 landscapes (Table 1). Mean breeding season abundance of bobwhites differed among landscapes ($\chi^2_2 = 6.65$, $P = 0.036$). Routes inside the RCW HMA with >50% of the landscape in RCW management had greater abundance ($\bar{x} = 9.13$ bobwhites, SE = 1.28) than either landscapes inside the HMA with <50% of the landscape in RCW management ($\bar{x} = 4.04$ bobwhites, SE = 0.79) or outside the HMA ($\bar{x} = 2.75$ bobwhites, SE = 0.40).

Discussion

Management strategies that enhance RCW habitat quality are designed to reduce hardwood midstory vegetation and create an open pine-grassland forest structure using mechanical hardwood midstory removal and short fire intervals (USFS 1995). By reducing hardwood midstory cover and basal area, these practices dramatically increase the amount and height of herbaceous cover (Wilson et al. 1995, Cooper 1996, Bowman et al. 1999). These changes in plant species composition and structure result in a corresponding change in avian community composition and abundance (Lucas 1993, Wilson et al. 1995, Burger et al. 1998). Bowman et al. (1999) measured vegetation structure for a sample of the stands that we monitored on HNF. They reported that RCW stands on HNF had lower relative frequency of overstory hardwoods, lower vertical vegetation density, and greater percentage cover of grasses, forbs, and understory shrubs than stands under traditional USFS management (Bowman et al. 1999).

We observed 232% greater abundance of bobwhites in landscapes with a large (66%) percentage dedicated to RCW habitat management than those with less (47%) or little (7.5%) RCW management. In landscapes with an intermediate extent

of RCW management (47%), we observed only 46% greater mean relative abundance than landscapes with little RCW management. Cram et al. (2002) similarly observed greater breeding season bobwhite abundance in short-leaf pine stands managed for pine-grassland restoration, with least abundance in unmanaged stands. During our study, relative abundance of male bobwhites in landscapes with a high extent of RCW management was similar to that reported by Cram et al. (2002) for stands thinned but not burned and thinned and burned three years prior. Relative abundance in landscapes with intermediate extent of RCW management was similar to that reported by Cram et al. (2002) for stands thinned and burned one year prior to sampling. However, Cram et al. (2002) used playback calls to elicit calling responses and reported that play-backs increased detection of an additional 0.4–0.9 males/point. Because we did not use call-backs to elicit response, observed relative abundance during our study was likely underestimated relative to that reported by Cram et al. (2002).

Because habitat management for RCWs opens the canopy, reduces the understory, and stimulates herbaceous ground cover (Cooper 1996), habitat quality for ground foraging birds such as bobwhites is enhanced. Fuller (1994) reported that radiomarked bobwhites on Noxubee National Wildlife Refuge preferentially used stands managed for RCWs disproportionately to their availability in the landscape. This preference was likely a result of differing food resource availability and better vegetation structure in the ground cover layer (greater herbaceous height, cover, and grass ground cover) consistent with bobwhite needs. In restored pine-grassland stands in Arkansas, percentage of forb and woody cover, suitable habitat within a 400-m radius of the sampling point, and overstory canopy cover (%) best explained bobwhite relative abundance (Cram et al. 2002). Stands managed for RCWs may provide greater food resources and better quality foraging habitat. Fuller (1994) reported that stands managed for RCWs supported greater abundance and biomass of arthropods than unmanaged stands. During the breeding season arthropods provide an essential food resource for chicks and reproductively active females (Hurst 1972, Jackson et al. 1987, Brennan and Hurst 1995).

Habitat management for RCWs enhances bobwhite habitat by creating and maintaining pine-grassland communities to which bobwhite are adapted. Specifically, this management regime opens the canopy, reduces hardwood midstory, enhances the grass/forb community, and increases seed producing plants and invertebrates. When applied to large landscapes, RCW management increases usable space (Guthery 1997), enhances distribution of suitable plant communities, and may connect isolated habitat patches contributing to increased landscape-level abundance and regional population stability. Quantity of pine-grassland restoration in the landscape may influence magnitude of population response to creation of habitat at the stand level. Cram et al. (2002) reported that hectares of suitable surrounding habitat was an important predictor of relative abundance within a stand. They suggested that small, isolated stands may provide suitable vegetation structure, but not support viable populations of bobwhite due to lack of suitable surrounding habitat. They suggested a threshold may exist and through simulation demonstrated that in their

landscape, the addition of 40 ha of suitable habitat within 400 m resulted in the addition of one calling male/point. During our study, we observed a relatively modest increase in relative abundance of bobwhite between landscapes with little pine-grassland restoration and those with an intermediate amount. However, we observed a marked and disproportionate increase in relative abundance of calling males when 66% of the landscape in a 800 m radius of point count stations was managed for RCWs, suggesting a threshold and/or non-linear response.

Although RCW management guidelines have been developed based on habitat needs of an endangered species and habitat specialist, implementing these practices in a broad context will contribute to restoring southern, fire-maintained pine-grassland ecosystems. Consequently, RCW habitat management constitutes ecosystem management from which many early successional, fire-adapted species such as RCWs and bobwhites likely benefit (Brennan 1991, Lucas 1993, Wilson et al. 1995, Wood et al. 2004). Pine-grassland restoration is most likely to elicit measurable population responses by bobwhites when conducted intensively and extensively, expanding existing restored stands and connecting isolated patches.

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