Open Pine Landbird Plan
West Gulf Coastal Plain/Ouachitas

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West Gulf Coastal Plains/Ouachitas Open Pine Landbird Plan

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OPEN PINE

INTRODUCTION

Pine forests and woodlands with low canopy cover, low basal area, and an open grassy or herbaceous understory are relatively uncommon in the West Gulf Coastal Plain and Ouachita Mountains (WGCPO), yet provide important habitat for priority bird species and other wildlife. Formerly common within the WGCPO, "open" pine habitat was historically maintained by periodic fires. With fire suppression and conversion of native pine forest to pine plantations planted at high stem densities, many of the bird species dependent upon this habitat have markedly declined. Therefore, conservation of open pine habitat is a high priority action for natural resource agencies and organizations. This chapter defines "open pine" habitat, lists priority bird species within this habitat, and identifies umbrella species representative of the needs of priority birds dependent on open pine habitat. For each umbrella species we describe the habitat structure necessary for viable populations, set population and habitat goals based on stated assumptions, and describe a decision support tool intended to help guide management actions supporting conservation of open pine habitat.

HABITAT DESCRIPTION

Open pine is defined as "*Forest that is greater than 80 percent pine, with canopy cover between 25 and 60%.*" It includes habitats commonly considered pine savanna and pine woodland. Native, mature stands of pine currently are uncommon in the WGCPO, and remnant open pine stands composed of longleaf pine (*Pinus palustris*) or shortleaf pine (*Pinus echinata*) are threatened by conversion to plantations of other pine species, land speculation, development, or conversion to pasture.

Suppression of wildfires and lack of prescribed burning has resulted in significant changes to native pine forests, allowing these formerly open, park-like stands to be invaded by hardwood species. With prolonged absence of fire, a dense hardwood midstory develops beneath the pine overstory, limiting sunlight at the forest floor. As canopy closure increases, herbaceous plant species disappear, and pine regeneration is limited to gaps in the canopy. Restoration of severely degraded pine habitats involves thinning of pines and/or complete or partial removal of hardwood canopy and shrub midstory to re-establish light penetration to the forest floor, and subsequently reintroducing periodic fire (e.g., prescribed burning) to control hardwoods.

Longleaf Pine Forests

Longleaf pine (*Pinus palustris*), historically was the predominant forest type in much of the southeastern United States having once covered 92 million acres. Over the past two centuries, the longleaf pine ecosystem has declined over 97 percent to less than 2 million acres (Jose et al. 2006). The longleaf pine-bluestem vegetation series, historically found in the southern portions of the West Gulf Coastal Plain, is threatened throughout its range and is extremely rare throughout the WGCPO.

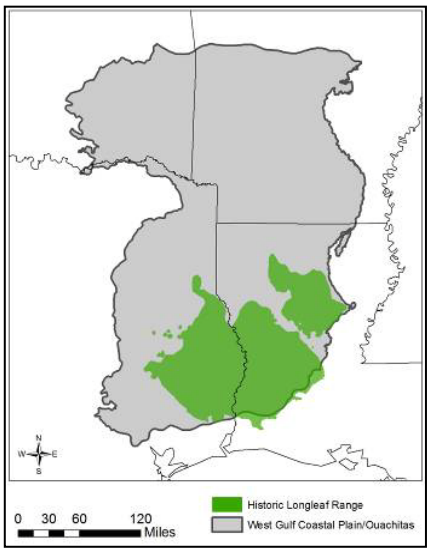


Figure 1. Historical distribution of longleaf pine (*Pinus palustris*) within the West Gulf Coastal Plain and Ouachitas Bird Conservation Region

Longleaf pine produces the highest quality timber products of all southern pines, including the production of high quality poles and sawtimber. In addition, this species is more resistant to insect infestation, disease, wind damage, and fire. Most landowners have chosen to plant loblolly pine *(Pinus taeda)* within the historic range of longleaf pine when reforesting their property, because loblolly is easier to establish on some sites, and due to the perception that return on the investment can be recouped at an earlier date when reforesting with loblolly pine. However, containerized longleaf pine seedlings, if planted properly, establish almost as quickly as loblolly pine. At maturity, a higher percentage of longleaf pine within the stand can be harvested for poles and sawlogs, which can yield greater financial return than pulpwood. Demonstrated rates of establishment and realization of increased financial return from longleaf pine could serve as an impetus for a significant number of landowners to return loblolly pine plantations and pastures to longleaf pine forests.

Shortleaf/Loblolly Pine Forests

Shortleaf pine (*Pinus echinata*) was historically the dominant canopy species in open pine habitats within the WGCPO north of the distribution of longleaf pine. At present, much of the land on National Forests in Oklahoma and Arkansas is managed as open shortleaf pine habitat. Even so, much of the suitable and potential open pine habitat on private lands in Texas and northern Louisiana is dominated by loblolly pine. The same bird species that benefit from open longleaf pine habitats also benefit from open shortleaf and loblolly stands.

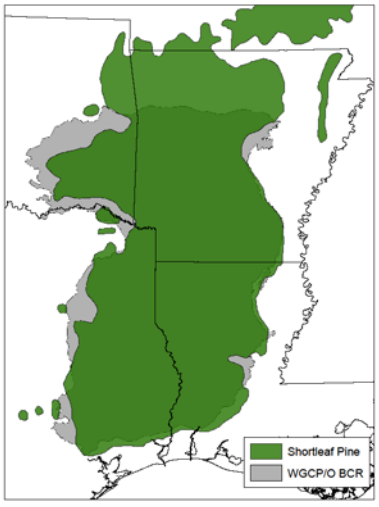


Figure 2. Natural distribution of shortleaf pine (*Pinus echinata*) within the West Gulf Coastal Plain and Ouachitas Bird Conservation Region (WGCPO BCR) from Little (1971).

Ouachita Mountains – Shortleaf Pine/Bluestem Woodland.-- These pine-dominated woodlands have intermittent canopy and abundant herbaceous groundcover. Fire maintains open canopies and allows prairie species to flourish.

Ouachita Mountains – Pine-Oak Forest.--In these mixed forests, *Pinus echinata* is an important or dominant species but occurs with a variable mixture of hardwood species. The composition of hardwoods is related to aspect and topographic factors such that hardwood composition may be greater than pine, especially on mesic sites (Dale and Ware 1999).

West Gulf Coastal Plain –Dry Pine-Hardwood Flatwoods.--This forest type is typified by dry flatwoods on Pleistocene high terraces, typically outside the floodplain. Soils are fine-textured and hardpans may be present in the subsurface to afford shallowly perched water tables after precipitation. Soil moisture fluctuates widely from saturated to very dry (a.k.a., hydroxeric). Drier sites support *Pinus taeda* and *Quercus stellata*; more mesic sites have *Pinus taeda* with *Quercus phellos* and species such as *Symplocos tinctoria* and *Viburnum dentatum*. Fire is an important natural process in this system (T. Foti pers. comm.).

West Gulf Coastal Plain – Pine-Hardwood Forest.--This ecological system consists of forests and woodlands dominated by *Pinus taeda* and/or *Pinus echinata* in combination with hardwood species. Historically present on nearly all uplands in the region except on edaphically limited sites (e.g., droughty sands, calcareous clays, and shallow soil barrens/rock outcrops). These forests have been largely converted to cultivated pine plantations.

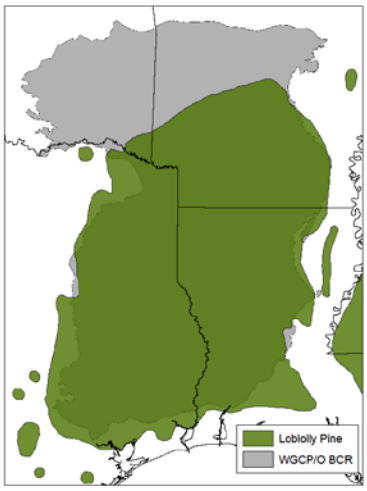


Figure 3. Natural distribution of loblolly pine (*Pinus taeda*) within the West Gulf Coastal Plain and Ouachitas Bird Conservation Region (WGCPO BCR) from Little (1971).

West Gulf Coastal Plain – Sandhill Oak-Shortleaf Pine Forest.--These forests are on uplands underlain with deep, coarse sandy soils, typified by low fertility and moisture retention. They typically have open (<60% closure) tree canopies with sparse understory vegetation and abundant bare soil. Canopy species are tolerant of drought, especially *Quercus incana* and *Pinus echinata*. Fire is a critical natural disturbance process.

BIRDS OF OPEN PINE HABITAT IN THE WGCPO

Priority Species

Eleven bird species have been designated as warranting conservation concern or given priority status in open pine habitats of the WGCPO (Table 1). These species were selected from 20 species included in the 2003 Draft Bird Conservation Plan for the West Gulf Coastal Plain Physiographic Area priority list for pine savanna (unpublished document; available at http://gcpolcc.ning.com/group/wgcpolandbirdworkinggroup). We retained species designated as Birds of Conservation Concern by the U.S. Fish and Wildlife Service (2008, 2009), species that occurred in at least 1 State Wildlife Action Plan (SWAP) of the four WGCPO states (Arkansas, Louisiana, Oklahoma and Texas), and eastern wild turkey (*Meleagris gallopavo silvestris*). We

included eastern wild turkey, even though it is not included in U.S. Fish and Wildlife Service nor any State priority list, due to its high priority status for the general public, the potential for its management to provide a means to benefit other species in this habitat, and its value as a communication tool for land managers that often focus on game animals. Species dropped from our priority list included: eastern wood-pewee, (*Contopus virens*) pine warbler (*Setophaga pinus*), ruby-throated hummingbird (*Archilochus colubris*), summer tanager (*Piranga rubra*), yellow-breasted chat (*Icteria virens*), yellow-throated warbler (*Setophaga dominica*), Carolina chickadee (*Poecile carolinensis*), eastern kingbird (*Tyrannus tyrannus*) and loggerhead shrike (*Lanius ludovicianus*). Because open pine is not the primary habitat for these species, we believe that retaining their designation as priority species in open pine habitat could unnecessarily detract from conservation efforts in other habitats with greater value for these species.

We note that although pine warbler was considered an umbrella species in the 2003 Draft WGCP Bird Conservation Plan, we did not include it as a priority in open pine habitat because it uses a broad range of pine forest conditions, including: isolated pine trees in suburban settings, small clusters of pine trees, closed-canopy pine plantations, and open pine forests. Thus, due to its broad niche of habitats, pine warblers poorly represent open pine habitat and population change of pine warblers likely does not reflect change in open pine habitats.

Table 1. Priority bird species of open pine habitats in the West Gulf Coastal Plain and Ouachita Mountains Bird Conservation Region.

Species	2003 Draft Plan[1]	2009 USFWS Priority[2]	SWAP GCN Species[3]
Northern bobwhite (*Colinus virginianus*)	X		All States
Eastern wild turkey (*Meleagris gallopavo silvestris*)	X		
American kestrel (*Falco sparverius paulus*)	X	X	TX
Red-headed woodpecker (*Melanerpes erythrocephalus*)	X	X	AR, OK, TX
Red-cockaded woodpecker (*Picoides borealis*)	X		All States
Brown-headed nuthatch (*Sitta pusilla*)	X	X	All States
Sedge wren (*Cistothorus platensis*)	X		AR, LA, TX
Prairie warbler (*Setophaga discolor*)	X	X	All States
Bachman's sparrow (*Peucaea aestivalis*)	X	X	All States
Henslow's sparrow (*Ammodramus henslowii*)	X	X	All States
Le Conte's sparrow (*Ammodramus leconteii*)	X		All States

[1] Partners in Flight 2003 Draft Bird Conservation Plan for the WGCPO

[2] Birds of Conservation Concern, U.S. Fish and Wildlife Service (2008, 2009)

[3] State Wildlife Action Plan species of Greatest Conservation Need (GCN) for Arkansas, Louisiana, Oklahoma, and Texas.

Umbrella Species

Four species, red-cockaded woodpecker (*Picoides borealis*), Bachman's sparrow (*Peucaea aestivalis)*, brown-headed nuthatch (*Sitta pusilla*), and northern bobwhite (*Colinus virginianus*), are designated as "umbrella species" having collective habitat requirements we considered sufficient to meet the needs of all priority species in open pine habitat.

Red-cockaded Woodpecker.—Red-cockaded woodpecker is dependent on older, more mature (~>80 year old) pine stands that have little to no midstory, such as those maintained via frequent (2-5 year) fire regimes. This species requires large (40.5 to 161.9 ha [100 to 400 ac] USFWS 2003) patches of suitable habitat (i.e., open old-growth pine forest) which historically ranged throughout the WGCPO. The presence of red-cockaded woodpeckers is considered indicative of an open pine forest with relatively low pine basal area (<20 m^2/ha [<90 ft^2/ac]; BA), low density of hardwoods (10 to 30% of the canopy trees [USFWS 2003]) and large pine trees (>35 cm [>14 inch] diameter at breast height; dbh). The large home range (230 ha [585 ac]) of red-cockaded woodpeckers is generally considered large enough to meet minimum habitat requirements for most species of concern in open pine habitat. Unfortunately, red-cockaded woodpeckers have a very low rate of colonization (pioneering) attributable to a paucity of source populations, stringent requirements for cavity excavation, the social dynamics of a cooperative breeding strategy, and a relatively small (1.6 to 8 km [1 to 5 miles]) dispersal distance for young birds.

Brown-headed Nuthatch.—Brown-headed nuthatch is reliant on older, mature pine stands much like those used by red-cockaded woodpeckers. But unlike the red-cockaded woodpecker, brown-headed nuthatches readily colonize open pine habitat as new habitat is created or as a stand matures. In addition, this species has the desirable qualities of: (1) being readily detected during surveys and (2) responding to changes on the landscape in a relatively short-time period. These characteristics allow planners and managers to more easily obtain feedback on population response to habitat conditions and thereby evaluate prescribed management practices. Finally, due to its dependence on snags, a site with sufficient standing deadwood to sustain brown-headed nuthatch populations will also likely provide sufficient standing deadwood for other primary and secondary cavity nesting species.

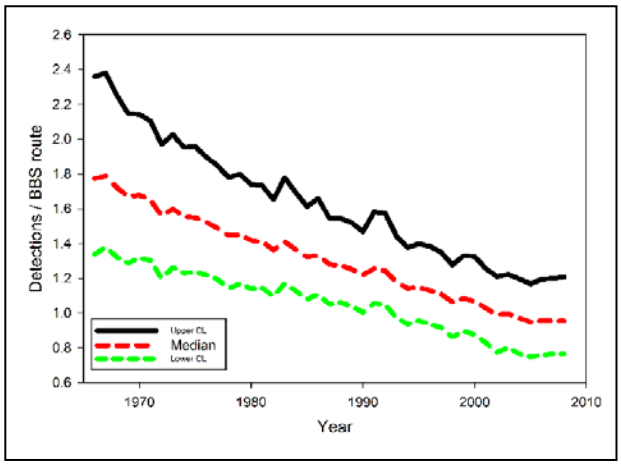


Figure 4. Annual abundance of brown-headed nuthatch on Breeding Bird Survey routes within the West Gulf Coastal Plain and Ouachita Mountains from 1966 through 2009 estimated from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010).

Northern Bobwhite.—Within open pine habitats, northern bobwhite requires a well developed herbaceous layer for nesting and brood cover. Even so, northern bobwhite exhibits a negative response to an herbaceous layer that is too dense or shrubby. As lack of frequent fire encourages encroachment of woody species, frequent (2 – 5 year intervals) prescribed fires contribute to development of a robust and diverse herbaceous layer favored by northern bobwhite. The presence or absence of northern bobwhite can be used as an indicator of the quality of the herbaceous component in open pine habitat and provides feedback on prescribed management actions. Additionally, the patch size requirement (>400 ha [>1,000 ac]) of northern bobwhite is relatively large. Hence, providing high quality open pine habitat for northern bobwhite will help ensure habitat is available to other species of management concern.

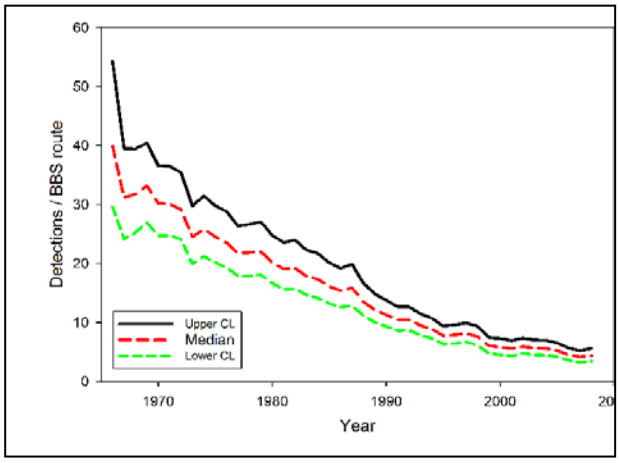


Figure 5. Annual abundance of northern bobwhite on Breeding Bird Survey routes within the West Gulf Coastal Plain and Ouachita Mountains from 1966 through 2009 estimated from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010).

Table 2. Key limiting habitat characteristics of 4 umbrella species, northern bobwhite (NOBO), red-cockaded woodpecker (RCWO), brown-headed nuthatch (BHNU), and Bachman's sparrow (BACS) in open pine habitats in the West Gulf Coastal Plain/Ouachitas Bird Conservation Region.

Habitat Factor	NOBO	RCWO	BHNU	BACS
Large patch size (>230 ha [>585 ac])	X	X		
Low pine basal area (<20 m^2/ha [<90 ft^2/ac])	X	X		
Low hardwood basal area (<5 m^2/ha [<20 ft^2/ac])	X	X		X
Low canopy cover (<60%)	X	X		X
Dense herbaceous ground cover	X			X
Short distance (<3 km [<1.9 mi]) to nearest patch (connectivity)	X		X	X
High snag density (>40 snags/ha [16.2 snags/acre))			X	
Large diameter (>35 cm [>14 inch] dbh) pines		X	X	

Bachman's Sparrow.— Bachman's sparrow is considered the quintessential grassland bird species in open pine habitat. Its presence is indicative of a well developed herbaceous layer. Bachman's sparrow appears to readily colonize new habitats, although high connectivity among open pine patches likely enhances their dispersal. Thus, in the absence of red-cockaded woodpeckers, possibly due to poor colonization ability, the presence of Bachman's sparrows may provide managers positive feedback on the effectiveness of prescribed management actions.

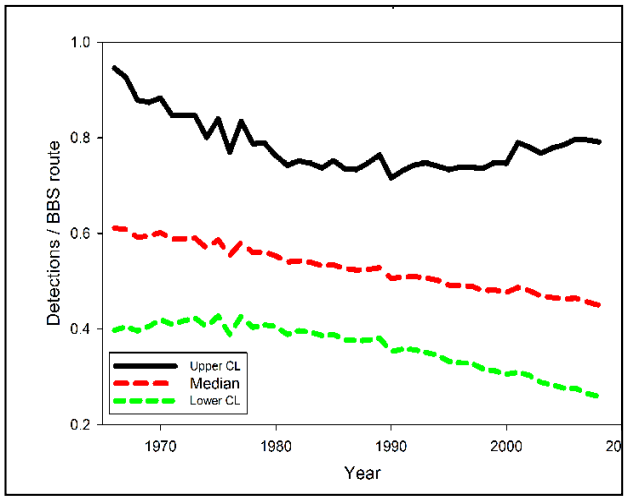


Figure 6. Annual abundance of Bachman's sparrow on Breeding Bird Survey routes within the West Gulf Coastal Plain and Ouachita Mountains from 1966 through 2009 estimated from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010).

POPULATION & HABITAT OBJECTIVES

Background & Rationale

Establishing habitat objectives for umbrella species requires knowledge of the relationship between sustainable populations and habitat conditions. For red-cockaded woodpecker, we accepted the objectives established by the Red-cockaded Woodpecker Recovery Plan, 2nd Revision (U.S. Fish and Wildlife Service 2003; Table 7). For northern bobwhite, brown-headed nuthatch, and Bachman's sparrow, we considered the approach outlined in Mueller et al. (2000) for developing habitat objectives for breeding birds. Central to this approach is identification of minimum patch size requirements for source populations as:

$$(1) \quad A = (N * D) + B, \text{ where}$$

A = area of forest patch required to support a source (i.e., sustainable) population,
N = number of reproductive units (i.e., pairs) required to support a source population,
D = breeding density (ha/breeding pair),
B = the area of a 1-km forested buffer around the forested core that ensures productivity of population within forested core is self-replacing.

However, umbrella species in open pine are not common hosts of nest parasites within the WGCPO, and their nesting habits (well-concealed and/or cavity nests) reduce their vulnerability

to many predators that strongly influence open-cup nesting species in fragmented landscapes. Therefore, we eliminated the forested buffer parameter (*B)* from the above equation in its application to open pine species. We note that a similar conclusion was reached in calculation of minimum patch size calculations for pine warbler and brown-headed nuthatch in the 2003 Draft WGCPO Bird Conservation Plan.

Estimating Model Parameters

To estimate the remaining parameters, we looked to the literature and other conservation planning efforts (e.g., East Gulf Coastal Plain Joint Venture's Decision Support Tool for Longleaf Conservation [Grand et al. unpublished]). To quantify *N*, we used minimum viable population (MVP) estimates calculated by Grand et al. (unpublished) based on the variability around simulated population trajectories from Breeding Bird Survey (BBS) data (Table 3). A sustainable population was defined as a population large enough to have >95% chance of remaining above 25 individuals over a 50-year interval (Grand et al. unpublished).

Densities (D) of breeding priority landbirds were generalized from published estimates of home-range area: ~3 ha/pair for Bachman's sparrow (Haggerty 1998, Stober and Krementz 2006), 3.6 ha/pair for brown-headed nuthatch (Withgott and Smith 1998) and ~20 ha/nest for northern bobwhite (Bell et al. 1985; Table 3). To estimate the area of forest patch required to support a source (i.e., sustainable) population (A = D*N), we found that restricting *A* to contiguous habitat was likely inappropriate in the predominantly forested WGCPO. Thus, rather than viewing *A* as the minimum size of an individual forest patch, we considered *A* as the minimum amount of habitat required within a specified landscape for a source population to exist. This distinction allows habitat that occurs in smaller, physically isolated blocks to contribute to habitat and population goals, an accounting that more likely tracks the reality of habitat configurations used by priority species within the WGCPO. Even so, for each priority species, individual patches of suitable habitat must be able to support ≥1 breeding pair, the juxtaposition of suitable habitat patches must allow movement (dispersal) among them (i.e., a meta-population), and the total habitat within a landscape must be sufficient to support a viable (sustainable) population.

Based on these caveats, for each species we assumed that to support a minimum viable population: (1) the minimum suitable habitat patch could support a home range or territory (*D*), (2) the total area of habitat (*A*) needed was the area required to support the size (N), (3) only habitat patches that were suitably connected (i.e., within dispersal distance [F]) contribute to the population occupying area (A).

Table 3. Total area (A) required to support an estimated minimum viable population (N) of 3 priority species in the West Gulf Coastal Plain/Ouachitas Bird Conservation Region in habitat patches (≥D) that support at least 1 breeding pair, each of which is physically located within dispersal distance (F) of another suitable habitat patch.

Species	Minimum Viable Population Size (*N*; pairs)[a]	Breeding density (*D*; ha/pair)	Area required to support *N* (*A;* ha)	Dispersal distance (*F*; km)
Northern bobwhite	60	6.8[b]	408	3
Brown-headed nuthatch	28	3.55[c]	84	1.8[e]
Bachman's sparrow	46	3[d]	138	3[f]

[a]From Grand et al. (unpublished manuscript). A Decision Support Tool for Longleaf Conservation in the East Gulf Coastal Plain (9 July 2009 Draft). 27 pp.

[b] Nest density (Brennan 1999).

[c] Mean of densities from 7 sites in pine habitat within the WGCPO (Withgott and Smith 1998; Table 4).

[d] Generalized from Haggerty 1998 (2.5 ha/pair) and Stober and Krementz 2006 (2.95 ha/pair).

[e] From Grand et al. (2009); estimated via allometric equation from Sutherland et al. (2000).

[f] Dunning et al. (1995).

Table 4. Density of breeding brown-headed nuthatches in pine habitats with the WGCPO. Extracted from Withgott & Smith (1998; Table 3).

pair/40 ha	Habitat	State	Source
26.00	46-yr loblolly pine	LA	Noble & Hamilton 1975
2.00	Shortleaf-loblolly-oak	AR	James and Neal 1986
4.50	Shortleaf pine, 3 yr post burn	AR	Wilson et al. 1995
11.90	Shortleaf pine, 2 yr post burn	AR	Wilson et al. 1995
18.40	Shortleaf pine, 1 yr post burn	AR	Wilson et al. 1995
4.00	65-yr loblolly-shortleaf	TX	Dickson and Segelquist 1979
12.00	26-yr loblolly-shortleaf	TX	Dickson and Segelquist 1979
Mean = 11.26	(3.55 ha / pair)		

A minimum regional habitat objective (*H*) can be calculated for each species, based on the amount of habitat (*A*) required by sustainable populations of size *N* when connectivity among habitat patches supporting at least one breeding pair is less than dispersal distance (*F*), as:

(2) $H = A * (P / N)$, where

H = minimum regional habitat objective,
A = amount of forest required by a sustainable population of size N,
P = regional population objective (number of pairs),
N = number of reproductive units (i.e., pairs) required to support a source population.

To establish regional population objectives (*P*) for northern bobwhite, brown-headed nuthatch, and Bachman's sparrow, we considered 3 time horizons that reflect: (1) short-term goals that can be realistically achieved within a reasonable timeframe, (2) more pragmatic medium-term goals, and(3) aspirational, long-term goals .

Our short-term goal is to stabilize the population trends of priority species (Figures 7, 8, and 9), as indexed by the change in abundance detected on Breeding Bird Survey routes over the most recent 5 years as assessed via trend analysis (http://www.mbrpwrc.usgs.gov/bbs/trend/tf09.html). For the period 2003-2007, these trend estimates (Link and Sauer 2002, Sauer et al. 2011; Table 4) were: Bachman's sparrow -3.55 ($CI_{95\%}$ = -11.53 – 4.74), brown-headed nuthatch -1.30 ($CI_{95\%}$ = -7.07 – 4.09), and northern bobwhite -7.25 ($CI_{95\%}$ = -11.30 – -3.80). The short-term population goal is to achieve a non-negative trend (i.e., have a neutral or positive slope in the linear equation) over the most recent 5-year period.

Table 5. Annual index of abundance (Link and Sauer 2002, Sauer et al. 2011) and median annual detections (Twedt et al. 2010) of northern bobwhite, Bachman's sparrow, and brown-headed nuthatch based on data from Breeding Bird Surveys within the West Gulf Coastal Plain/Ouachitas Bird Conservation Region, 2003-2007.

	Northern bobwhite		Brown-headed nuthatch		Bachman's sparrow	
Year	Index	Median	Index	Median	Index	Median
2003	8.29	5.626	1.24	0.9966	0.12	0.4842
2004	7.89	5.554	1.14	0.9702	0.12	0.4832
2005	6.98	5.209	1.07	0.9483	0.11	0.4811
2006	6.57	4.509	1.13	0.9565	0.12	0.4839
2007	5.68	4.136	1.15	0.9548	0.10	0.4761
Linear Regression[1]	-0.4025x + 6.2143		-0.0097x + 0.9945		-0.0015x + 0.4864	

[1] Median annual detections; x = (year-2002)

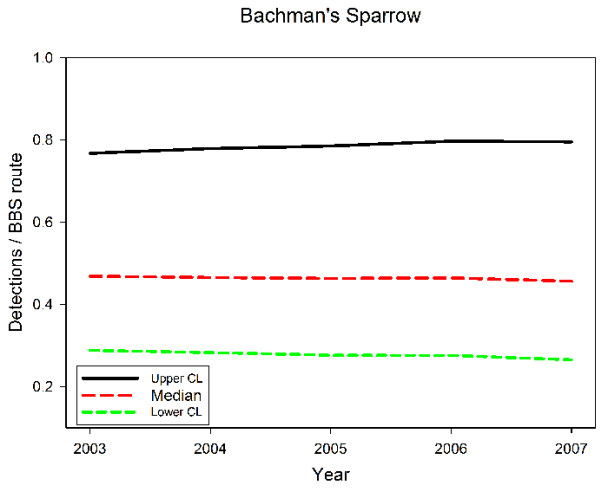


Figure 7. Estimated median annual abundance (detections) of Bachman's sparrow on Breeding Bird Survey routes within the West Gulf Coastal Plain/Ouachitas BCR from 2003 through 2007 from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010).

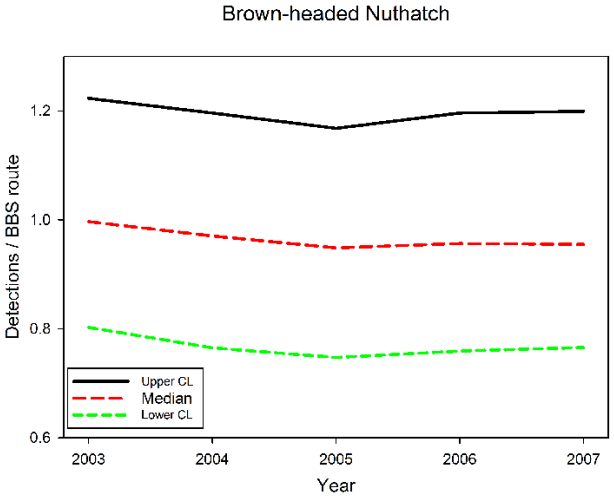


Figure 8. Estimated median annual abundance (detections) of brown-headed nuthatch on Breeding Bird Survey routes within the West Gulf Coastal Plain/Ouachitas BCR from 2003 through 2007 from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010).

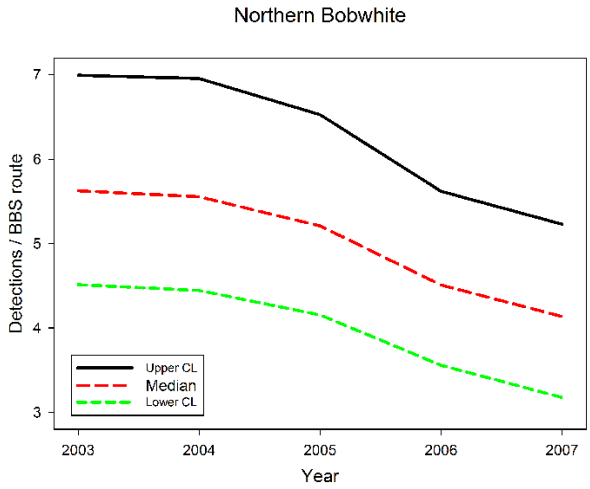


Figure 9. Estimated median annual abundance (detections) of northern bobwhite on Breeding Bird Survey routes within the West Gulf Coastal Plain/Ouachitas BCR from 2003 through 2007 from hierarchical models employing Markov chain Monte Carlo sampling (Twedt et al. 2010

The medium-term and long-term objectives for priority landbirds in the WGCPO Bird Conservation Region are to return populations to levels of circa 1980 (consistent with the objective associated with the National Bobwhite Conservation Initiative) and 1968 (consistent with objectives associated the North American Landbird Conservation Plan), respectively. To quantify these objectives, we used: (1) an estimate of "current" population size and (2) the relative magnitude of change in population size between the objective time periods and the present. Current population size was determined by applying Rosenberg and Blancher (2005) corrections to the outputs of predictive models that estimated breeding bird survey (BBS) abundance as a function of habitat suitability index (HSI) scores (Jones-Farrand et al. 2009, Tirpak et al. 2009*a*, Tirpak et al. 2009*b*; Table 4). Relative magnitude of change in population size between objective baseline time periods and the present was determined by dividing the average count per BBS route (from BBS trend analysis; http://www.mbr-pwrc.usgs.gov/bbs/trend/tf09.html) for northern bobwhite, brown-headed nuthatch, and Bachman's sparrow within 5-year windows surrounding 1969 (1967-1971) and 1980 (1978-1982) by the average count per BBS route during the 5-year window surrounding the date of the 'current' population estimate (2001; 1999-2003). Derivation of population objectives (*P)* for the medium and long-term time horizons then consisted of multiplying the current population estimate (*C*) by the average relative BBS abundance from either 1978-1982 (*BBS1980*) or 1967-1971 (*BBS1969*) divided by the average relative BBS abundance from a time contemporaneous with the current population estimate (*BBS2001*) (i.e., 1999-2003):

$$(3) \quad P_{medium\text{-}term} = C * (BBS1980/BBS2001), \text{ and}$$

$$(4) \quad P_{long\text{-}term} = C * (BBS1969/BBS2001),$$

where values used in determining population objectives for these two time horizons are provided in Table 5.

Although the WGCPO Landbird Working Group felt that the state-based, objective BRI approach employed by the NBCI precludes an equitable relative ranking of landscapes across the WGCPO, it is encouraging to note that the NBCI's (The National Bobwhite Technical Committee 2011) population objective (592,011 individuals) for this ecoregion (i.e., current estimated population in High and Medium BRI landscapes, plus the High BRI objective ["Management Density"] Table 8) compares well with this Plan's long term population objective (524,312 individuals; Table 6). Hence, two very different approaches to estimating populations and setting objectives render comparable results.

Table 6. Estimated 1990s populations (adjusted for sub-regional habitat suitability index [HSI] scores) and medium- and long-term population objectives for open pine umbrella species in the West Gulf Coastal Plain/Ouachitas Bird Conservation Region. Partners in Flight (PIF) estimated landbird populations from the North American Landbird Conservation Plan (Rich et al. 2004), which were based on Breeding Bird Survey data from the 1990s.

Variable	Northern bobwhite	Brown-headed nuthatch	Bachman's sparrow
PIF population estimate (*No. of pair*)	110,000	120,000	10,000
Percent of population in 'Open Pine'[a]	40%	100%	~100%
HSI adjusted 1992 population (*C=No. of pair*)	44,000[b]	120,379	9,913
Average BBS abundance 1999-2003 (*BBS2001*)	8.59	1.176	0.14
Minimum viable population (*N*; pairs)	60	28	46
Breeding density (*D*; ha/pair)	6.8	3.55	3
Area for *N* pair (*A;* ha)	408	99	138
Current habitat (ha)[c]	299,200	125,354	29,739
Average BBS abundance 1978-1982 (*BBS1980*)	38.86	1.542	0.524
Medium-term population objective ($P_{medium\text{-}term}$)	199,050	157,844	37,103
Population deficit for medium-term objective	(155,050)	(37,465)	(27,190)
Medium-term habitat objective ($H_{med\text{-}term}$ ha)	1,353,540	164,369	111,309
Medium-term habitat deficit (ha)	(1,054,340)	(39,015)	(81,570)
Average BBS abundance 1967-1970 (*BBS1969*)	51.18	1.866	1.068
Long-term population objective ($P_{long\text{-}term}$)	262,156	56,029	75,622
Population deficit for medium-term objective	(218,156)	(70,631)	(65,709)
Long-term habitat objective ($H_{long\text{-}term}$; ha)	1,782,661	198,903	226,866
Long-term habitat deficit (ha)	(1,483,461)	(73,549)	(197,127)

[a] 36% of birds in the WGCPO (calculated from data in the National Bobwhite Conservation Initiative, Table 20, page 97).

[b] 40% of PIF population estimate.

[c] Calculated as the product of HSI adjusted 1992 population estimate and assumed breeding density.

Table 7. Population and habitat objectives for red-cockaded woodpecker in the West Gulf Coastal Plain/Ouachitas Bird Conservation Region.

		PBGs[1]		Habitat (ac)	
Location	**State**	**Current[2]**	**Goal[3]**	**Current[4]**	**Goal[5]**
Crossett Experimental Forest	AR	1	0	1,680	1,680
Ouachita National Forest (secondary core recovery unit)	AR	57	400	50,000	120,000
Ouachita National Forest	AR/OK	0	0	10,000	61,000
Pine City Natural Area	AR	2	5	200	500
Private land	AR	0	30		17,665
USFWS: Felsenthal National Wildlife Refuge	AR	13	34	6,800	8,107
Alexander State Forest	LA	13	12	1,300	1,200
Department of the Army: Fort Polk (primary core recovery unit)	LA	53	179	32,282	32,282
Department of the Army: Peason Ridge Training Area	LA	25	120	19,116	19,116
Kisatchie National Forest: Calcasieu District Evangeline	LA	70	231	46,400	46,400
Kisatchie National Forest: Calcasieu District-Vernon (primary core recovery unit)	LA	160	302	63,800	63,800
Kisatchie National Forest: Catahoula District (secondary core recovery unit)	LA	118	317	73,000	73,000
Kisatchie National Forest: Kisatchie District	LA	50	292	60,200	60,200
Kisatchie National Forest: Winn District	LA	33	263	59,400	59,400
Private land	LA	101	101	7,575	7,575
USFWS: Black Bayou National Wildlife Refuge	LA	0	0	0	0
USFWS:D'Arbonne National Wildlife Refuge	LA	4	5	480	600
USFWS:Upper Ouachita National Wildlife Refuge	LA	1	1	200	200
McCurtain County Wilderness Area	OK	12	45	13,006	13,006
Ouachita National Forest	OK	0	0	5,000	41,000

Table 7. Continued.

Location	State	PBGs[1] Current[2]	PBGs[1] Goal[3]	Habitat (ac) Current[4]	Habitat (ac) Goal[5]
Private Lands	OK	0	0	0	0
Angelina/Sabine National Forests (primary core recovery unit)	TX	87	514	11,600	103,189
Davy Crockett National Forest (secondary core recovery unit)	TX	73	330	1,100	66,245
I.D. Fairchild State Forest	TX	2	7	1,400	1,400
Private land	TX	35	27	8,600	8,600
Sam Houston National Forest (primary core recovery unit)	TX	214	541	32,800	108,412
W.G. Jones State Forest	TX	3	10	1,600	1,600
TOTAL		**1,127**	**3,766**	**445,659**	**916,177**

[1]Potential Breeding Group – defined as an adult female and adult male that occupy the same cluster, whether or not they are accompanied by a helper, attempt to nest, or successfully fledge young (U.S. Fish and Wildlife Service 2003).

[2]Western Zone Red-cockaded Woodpecker Population Data Sheet 2010 and personal communication with local area managers.

[3]2003 Red-cockaded Woodpecker Recovery Plan, modified by Western Zone Recovery Group.

[4]Provided by local area managers.

[5]Based on USDA Forest Service Management Plans, safe harbor management agreements and memorandum of agreement

Table 8. Population and habitat parameters calculated from National Bobwhite Conservation Initiative (NBCI)objectives for upland pine habitat the West Gulf Coastal Plains/Ouachitas Bird Conservation Region by Biologist Rating Index (BRI).

	Arkansas		Louisiana		Oklahoma		Texas		TOTAL
Parameter	ED	MD	ED	MD	ED	MD	ED	MD	
HIGH BRI									
Density (ac/bird)[1]	23	5	31	10	0	0	0	0	
Estimated Current Birds	26,811	-	80,711		0	-	0	-	107,522
Estimated Birds with Management	-	123,330	-	250,205	-	0	-	0	373,536
Additional Birds with Management	-	96,519	-	169,494	-	0	-	0	266,013
Additional Coveys with Management	-	8,043	-	14,124	-	0	-	0	22,168
Existing Acres[1]	616,652.3		2,502,053.5		0.0		265.8		3,118,972
MEDIUM BRI									
Density (ac/bird)[1]	36	8	53	10	40	15	100	25	
Estimated Current Birds	132,766	-	33,036	-	27297	-	25,377	-	218,476
Estimated Birds with Management	-	597,447	-	175,092	-	72792	-	101,506	946,836
Additional Birds with Management	-	464,681	-	142,056	-	45495	-	76,130	728,361
Additional Coveys with Management	-	38,723	-	11,838	-	3791	-	6,344	60,697
Existing Acres[1]	4,779,572.4		1,750,917.2		1,091,880.6		2,537,650.3		10,160,021

[1] Data taken directly from NBCI (The National Bobwhite Technical Committee 2011)
ED = "Estimated Density", assumed density in existing, unimproved habitat
MD = "Managed Density", assumed additional carrying capacity with prescribed management

HABITAT MANAGEMENT

Well managed, open pine forests where prescribed fire is frequently (2-5 yr interval) implemented have the potential to sustain habitat which supports priority bird species. Open pine habitats composed of older trees maintained at relatively low canopy cover and basal area with sparse shrubby and abundant grassy understory provide the greatest benefit to priority bird species. Local and regional population declines in many bird species that breed in open pine habitats have been detected. Most of these species are dependent on a diverse herbaceous understory in fire-climax longleaf pine and shortleaf pine communities. These species are less likely to breed in areas with shrub and hardwood encroachment. Specific habitat and management requirements for the four umbrella species are detailed below.

Red-cockaded Woodpecker

Management for red-cockaded woodpeckers provides benefits to the entire open pine ecosystem. These benefits result from prescribed burning and retention of older pine trees. In addition, cavities created by red-cockaded woodpeckers are subsequently used by secondary cavity nesting species. Habitat management for red-cockaded woodpeckers merges with ecosystem management because: (1) the red-cockaded woodpecker is an indicator species whose populations track the health of southern pine ecosystems; (2) protection of red-cockaded woodpeckers provides simultaneous protection for many associated species (Provencher et al. 2002), and (3) the red-cockaded woodpecker is a keystone species whose presence influences the presence and/or abundance of other species (secondary cavity users) in the community (USFWS 2003).

Even so, management of upland pine communities may not be consistent with an ecosystem approach when prescribed fire and retention of older trees is focused on red-cockaded woodpecker clusters and not on the landscape. A red-cockaded woodpecker cluster is the aggregate of cavity trees previously and currently used and defended by a group of red-cockaded woodpeckers, with or without a 200-ft buffer of surrounding forest (USFWS 2003). Clusters that are managed within small, 4 ha (10 ac) minimum units provide limited benefits to other members of open pine communities. Moreover, management within small patches also has detrimental effects on red-cockaded woodpeckers, including decreased value of foraging habitat (James et al. 1997, Walters et al. 2000), increased cavity damage by pileated woodpeckers (*Dryocopus pileatus*) (Saenz et al. 1998), and increased mortality of cavity trees due to pests such as southern pine beetles (Conner et al. 1997, USFWS 2003)

The red-cockaded woodpecker requires mature (usually ≥80 years old), live pine trees to excavate its nesting and roosting cavities. Quality red-cockaded woodpecker foraging habitat includes large, old pines (≥18 trees per ac [44 per ha] at least 60 years old and 14 inches [35.6 cm] in diameter), low densities of small and medium pines (basal area of 40 to 60 sq. ft. per ac (3.7 to 5.6 sq. m) for longleaf and 40 to 80 sq. ft. per ac (3.7 to 7.4 sq. m) for loblolly and shortleaf), sparse or no hardwood midstory and overstory canopy (10 to 30% of the total canopy

[USFWS 2003]), and a well developed herbaceous understory. The groundcover of native bunchgrasses and other native, fire tolerant/dependent herbs should total 40 percent or more of ground and midstory plants and should be dense enough to carry a growing season fire once every 2-5 years. Such habitat should be contiguous to and within 0.5 mile (0.8 km) of a cluster and not separated by more than 200 feet (61 m) of non-forested habitat (USFWS 2003).

The Red-cockaded Woodpecker Recovery Plan, 2nd Revision (USFWS 2003), concludes that to establish a long-term, self-sustaining red-cockaded woodpecker population, a minimum effective population of 250 breeding groups is required to overcome the potential adverse effects of inbreeding, environmental and demographic stochasticity, and catastrophes. To offset losses of genetic variation caused by genetic drift, the Red-cockaded Woodpecker Recovery Plan, 2nd Revision, recommended a population size of 350 breeding groups, and states that exchange of breeding individuals among populations is desirable. Consequently, connectivity among populations is essential for the long-term survival of the species. These conditions result in an effective population size (Simberloff and Cox 1987) of >1000 individuals, as recommended by others (Lande 1995, Soule 1987, Thomas 1990).

Red-cockaded woodpeckers in Florida foraged in patches containing fewer but larger trees than patches chosen randomly (Bowman et al. 1997). In North Carolina sandhills they used patches containing larger trees and less hardwood midstory than in unused patches (Walters et al. 2000), and in Shortleaf pine forest of the Arkansas Ouachita Mountains were found more often in patches containing larger pines, a lower density pine overstory, and less hardwood midstory compared to randomly chosen patches (Doster and James 1998).

Red-cockaded woodpeckers require from 100 to 400 acres (40 to 162 ha) per group, depending upon the quality of foraging habitat, where high quality foraging habitat has intermediate pine density and is relatively free of hardwood midstory. The Red-cockaded Woodpecker Recovery Plan (USFWS 2003) is based on a home range of 200 ac (81 ha) per group such that the Plan's 350 breeding pair goal for each primary core population requires 70,000 ac (28,328 ha) of open pine habitat. Secondary core populations of 250 breeding pair require 50,000 ac (20,234 ha). As previously stated, these populations should have linkages sufficient to allow exchange of breeding individuals. The Red-cockaded Woodpecker Recovery Plan recommends 3 primary core populations, 3 secondary core populations, and 12 support populations in the WGCPO (Table 7). These 18 populations would comprise 3,766 red-cockaded woodpecker pair (groups), which we estimate require at least 753,200 ac (304,809 ha) of open pine habitat.

Habitat in each core area need not be contiguous, but must be in close proximity to facilitate genetic exchange and pair formation (Letcher et al. 1998). Habitat fragmentation between demographically isolated red-cockaded woodpecker groups may inhibit expansion of groups and contribute to their extirpation, but the effect of fragmentation decreases as population densities increase (Conner and Rudolph 1991). Within 6 red-cockaded woodpecker populations (3

primary core and 3 secondary core) on National Forests in the WGCPO, biologically and spatially distinct subpopulations are evident; where subpopulations are aggregates of red-cockaded woodpecker clusters separated by ≥5 miles (≥8 km) of currently suitable habitat, or ≥3 miles (≥ 4.8 km) of unsuitable habitat. Aggressive management of these subpopulations is imperative if the long range goal of connecting these subpopulations and forming the desired core recovery populations is to be attained.

One of the most important tools in maintaining open pine habitat for red-cockaded woodpeckers is frequent (2-5 year interval) prescribed burning. In the absence of fire, a dense hardwood mid-story develops beneath the pine overstory which limits sunlight at the forest floor such that herbaceous plants species disappear, and pine regeneration is limited to gaps in the hardwood canopy. In fire-suppressed forests, fuel accumulations become a wildfire hazard, the herbaceous grassy groundcover disappears, and birds such as the red-cockaded woodpecker, and others (e.g., eastern wild turkey, northern bobwhite, Bachman's sparrow, and Henslow's sparrow) disappear.

As red-cockaded woodpecker is a federally and state endangered species, programs are available to promote management of this species on private lands including: Memoranda of Agreements, Safe Harbor Programs, and Habitat Conservation Plans for Private Lands. State wildlife agency personnel can provide details on programs that support conservation of red-cockaded woodpeckers on private lands. These programs mitigate perceived disincentives for open pine management thereby helping restore a fire regime, lengthen timber rotations, and encouraging open pine habitat within the WCGP/O.

Bachman's Sparrow

In the WGCPO, Bachman's sparrow is designated a Bird of Conservation Concern by Partners in Flight. Based on BBS data, the decline in the southeastern United States, which is the sparrow's remaining stronghold, is significant at 8.1% per year over the past 40 years; since 1980, the decline has increased to 20.8 % per year (Fig. 7). Therefore, this species is in need of immediate management.

Bachman's sparrow responds to active forest management that results in an understory that is patchy, both horizontally and vertically, with a mid-story and overstory that are moderate (≤50%) in coverage. Management, including timber harvest and prescribed burning, are used to produce and sustain suitable Bachman's sparrow habitat. As plant communities in the WGCPO respond rapidly following treatment, management such as prescribed fire must be periodically applied (2-5 year intervals).

Bachman's sparrow responds best to a frequent fire interval of about 3 years (Dunning 1993). In East Texas, Bachman's sparrow abundance decreased significantly in areas once occupied when fire was excluded for 8 years (Conner et al., 2005). Frequent fire reduces hardwood encroachment and encourages development of forbs and grasses in the understory. Native warm-

season grasses that grow in small dense clumps or tufts, such as *Andropogon*, provide optimal foraging conditions and breeding sites (Haggerty 1998). Although there is debate about the immediate effects of prescribed summer burns on Bachman's sparrow movements and survival (Seaman and Krementz 2001, Cox and Jones 2007), burning is necessary for continued Bachman's sparrow occupancy of open pineland stands.

In addition to prescribed fire, timber harvests that result in reduced basal area (<90 sq ft /acre [<20 sq m/ha]) and canopy cover are beneficial for Bachman's sparrows. Optimal canopy cover has not been determined, but canopy cover >50% is usually coincident with loss of Bachman's sparrows (Tirpak et al. 2009b).

Breeding season home range of Bachman's sparrows are about twice as large in mature forested longleaf pine stands as in young (<5 years) clearcuts (Stober and Krementz 2006). Difference in home range size is likely linked to resource availability, which may be less in mature (more closed canopied sites) than early successional, open canopied sites (Stober and Krementz 2006). Thus, clear-cutting, heavy thinning (e.g., seed tree cut), or thinning may produce habitat for Bachman's sparrows. Alternatively, initiation of territories in early successional habitats has been found to be later than initiation in mature open pine habitats (Robert Allen, unpubl. data), suggesting that early successional habitats may be sub optimal when compared to those in mature open pine. Regardless, all these sites rapidly succeed to conditions that are unattractive to Bachman's sparrows in the absence of fire or other perturbation.

Herbicides, in all forest layers (ground, mid and canopy), can in some situations be used for managing habitat for Bachman's sparrows. The advantages of using chemicals include precision of application in space and time, specificity for targeted plants, and avoidance of collateral damages from fire or timber harvest (Miller and Miller 2004). However, chemical control of grasses would be detrimental to this species.

Site preparation following overstory reduction or removal may affect habitat suitability for Bachman's sparrows. Methods that do not destroy ground vegetation (e.g. burning before replanting) are preferred, as recolonization of these stands by Bachman's sparrows is faster compared to stands where ground vegetation is destroyed (e.g. windrowing) (Dunning 1993).

Home range size for breeding Bachman's sparrows ranges from 2 to 5 ha (5 to 12 ac), but varies by region, habitat type, and stand age (Tucker et al. 2004, Seaman and Krementz 2001, Stober and Krementz 2006, Cox and Jones 2007). Bachman's sparrows have shown limited dispersal movements, with dispersal movements of <5 km (>3.1 mi) in response to growing season burns (Dunning and Watts 1990, Seaman and Krementz 2001, Cox and Jones 2007). With limited dispersal ability, Bachman's sparrows require landscapes wherein patches of suitable habitat are interconnected in space and time. Thus, this species requires consideration of how timber harvest strategies may affect dispersion of suitable habitat patches (Pulliam et al. 1992, Seaman and Krementz 2001).

Northern Bobwhite

Northern bobwhite is designated as a species requiring management attention by Partners in Flight, primarily due to marked (-3%/year) range-wide population declines since 1966 (Sauer et al 2011). In the WGCPO during that same period northern bobwhite declined -4.4%/year (Fig. 9). To address declines in northern bobwhite populations, the Northern Bobwhite Conservation Initiative (NBCI) was established to restore and manage specific habitats used by bobwhite within Bird Conservation Regions (Dimmick et al. 2002). The goal of the NBCI was to restore northern bobwhite populations to an average density equivalent to that which existed in 1980 through use of regionally specific management recommendations (Dimmick et al. 2002). This plan was updated in 2011 with the National Bobwhite Conservation Initiative (The National Bobwhite Technical Committee 2011). The 2011 NBCI promotes population and habitat goals similar to the 2002 plan, but refined the geographic priorities for these using a Biologists Ranking Index (BRI). The BRI ranks local geographies (typically county/parish) as High, Medium, or Low priority based on a subjective assessment of a variety of factors, including current habitat quality and potential for management/restoration.

Northern bobwhites inhabit mature open pine and early successional habitats that have well developed and diverse herbaceous ground cover. Early-successional habitat occurs under conditions of frequent disturbance (burning, disking, roller chopping, etc.), immediately after tree harvest, or in association with fields in agricultural habitats that are interspersed with forest. Northern bobwhites thrive in habitats dominated by early successional vegetation, as found in the understory of open pine habitats. Historically, fires and tree mortality resulted in millions of acres of high quality bobwhite habitat across the southeastern United States, including the longleaf and shortleaf forests of the WGCPO (Dimmick et al. 2002). However, conversion of native forests to other land use, including altered silviculture, and associated reduction in early-succession habitat has reduced the areas of suitable habitat for bobwhites.

Management for northern bobwhite in open pine habitat should: (1) keep sunlight on the forest floor, and (2) provide ground vegetative structure that affords mobility, nesting cover, and forage opportunities (e.g., insects, legumes, and soft mast). Pine canopy cover ranging from 40% to 60% or basal area between 20 and 70 ft/ac (The National Bobwhite Technical Committee 2011) are considered optimal in southern pine forests, with the understory and midstory frequently disturbed (preferably with frequent fires) to set back plant succession and maintain grass and forb diversity (Dimmick et al. 2002). Where prescribed burning is not feasible, other means of setting back succession, such as fallow disking and roller chopping, may be effective.

These understory qualities enhance opportunities for feeding and travel by northern bobwhite. Optimal frequency and season of burning vary with site index, land use history, and other site-specific factors and objectives. Even so, burning at 2-3 year intervals generally results in quality habitat, although on fertile sites in the southern portion of the region a fire return interval of $\leq$2

years may be required to control hardwood encroachment. Burning a mosaic of relatively small (10 to 50 ac [4 to 20 ha]) non-adjacent patches in rotation, rather than large units (>100 ac [>40 ha]) affords food, nesting, and escape cover in the adjacent unburned areas while burned areas recover. Winter or early spring burns are suitable on most sites, but growing season burns (e.g., April-August) may be desirable to reduce hardwood encroachment and encourage legume and forb growth. Rotation of winter/early spring and growing season burns interspersed among a mosaic of small blocks will increase vegetative diversity.

Unlike the other three umbrella species that typify open pine habitats, quality habitat for northern bobwhite may include a mosaic of forest and open land (e.g., grasslands, pastures, haylands, row crops, small grains, or fallow) within the landscape. However, the relative benefits to northern bobwhite of a landscape with a high percentage of open land are diminished where the forest land in that landscape is composed of well-managed open pine.

Home range sizes for northern bobwhites vary with habitat condition, from 18 to 58 ha (45 to 143 ac) in Louisiana (Bell et al. 1985) up to 282 ha (697 ac) on poor sites in Mississippi (Lee 1994). Dispersal distance has been documented as high as 100 km (62 mi) in south Texas, but typical dispersal is <2 km (1.2 mi) (Brennan 1999).

Brown-headed Nuthatch

Brown-headed nuthatches are endemic year-round residents of mature, open pine habitats from east Texas to southeast Virginia. Greatest abundance occurs in stands with large snags, an open midstory, open canopy, and sparse understory maintained by fire or silvicultural thinning (O'Halloran 1984, Haney 1981).

Mature pine stands (mean dbh = 25 cm [10 in]; O'Halloran and Conner 1987, Dornak et al. 2004), with few hardwoods and an open midstory (Wilson and Watts 1999) provide optimal habitat for brown-headed nuthatch. Population density declines as the mid-story exceeds 20 feet (6 m) in height, apparently because taller midstory tends to obscure cavities and inhibits movement between higher foraging sites and lower nesting cavities (Dornak et al. 2004, Wilson and Watts 1999, Van Balen and Doerr, 1978). Brown-headed nuthatches are secondary cavity nesters, using cavities primarily in larger diameter snags that are <3 m (10 ft) in height (Paxton et al. 2004). Increased abundance of large snags likely improves reproduction and abundance of brown-headed nuthatches (Lloyd and Slater 2007, Wilson and Watts 1999, Land et al. 1989).

Fire increases habitat quality for brown-headed nuthatch by suppressing understory and midstory development. In Arkansas, greatest population densities occur the year after a burn (Wilson and Watts 1999, Wilson et al. 1995) and abundance is reduced in fire-suppressed areas (Allen et al. 2006). Similarly, in loblolly pine plantations, abundance was greatest immediately after mechanical thinning and decreased thereafter (Paxton et al. 2004, Wilson and Watts 1999).

Thus, growing season burns at intervals (2-5 years) that suppress understory and midstory woody growth are beneficial.

Breeding density varies with habitat quality: in Arkansas from 20 ha/pair (49 ac/pair) in shortleaf-loblolly-oak forest (James and Neal 1986) to 2.2 ha/pair (5.4 ac/pair) in shortleaf pine stands 1-year post-burn (Wilson et al. 1995) and, in Louisiana, 1.5 ha/pair (3.7 ac/pair) in 46-year old loblolly pine (Noble & Hamilton 1975). We calculated a mean breeding density of 3.55 ha/pair (8.77 ac/pair) from 7 stands in AR, LA, and TX (Withgott and Smith 1998; Table 4). Brown-headed nuthatches are relatively poor colonists, with short dispersal distances such that in Florida, females dispersed from 0.2 to 1.2 miles (0.3 to 1.9 km), whereas males dispersed 0.06 to 0.2 miles (J. Cox, Tall Timbers, pers. comm. In Hunter et al. unpublished Fire Management Species Profile: Brown-headed Nuthatch).

DECISION SUPPORT TOOL

General Approach

Knowing the amount of suitable habitat needed to support a viable population is only part of the information required for effective conservation. Specific site-scale conditions (understory structure, stand age, etc.) and landscape context (patch size, nature of surrounding landscape) are critical components of carrying capacity. The decision support tool (DST) described herein addresses important landscape factors. The objective for the open pine DST is to provide information helpful in placing open pine management (enhancement, prescribed fire, etc.) and protection activities in locations where they have the greatest chance of supporting viable populations of priority bird species. Due to unresolved issues regarding the parameters for northern bobwhite, the DST was created using information from the remaining three umbrella species: red-cockaded woodpecker, Bachman's sparrow, and brown-headed nuthatch.

Model Development

We assumed both the evergreen forest and mixed (evergreen and deciduous) forest, upon application of an appropriate management regime (e.g., prescribed fire and thinning), represent suitable habitat for priority open pine bird species. We identified the area and location of these forests using 2001 National Land Cover data. However, we assumed all forests in floodplains (bottomlands) were not suitable for open pine, and these areas were removed using a combination of a floodplain map (LMVJV unpublished data) for the lower WGCPO and the floodplain class of the land position layer from the HSI assessment (Tirpak et al. 2009b) for the upper WGCPO. For each of the three open pine umbrella species, we:

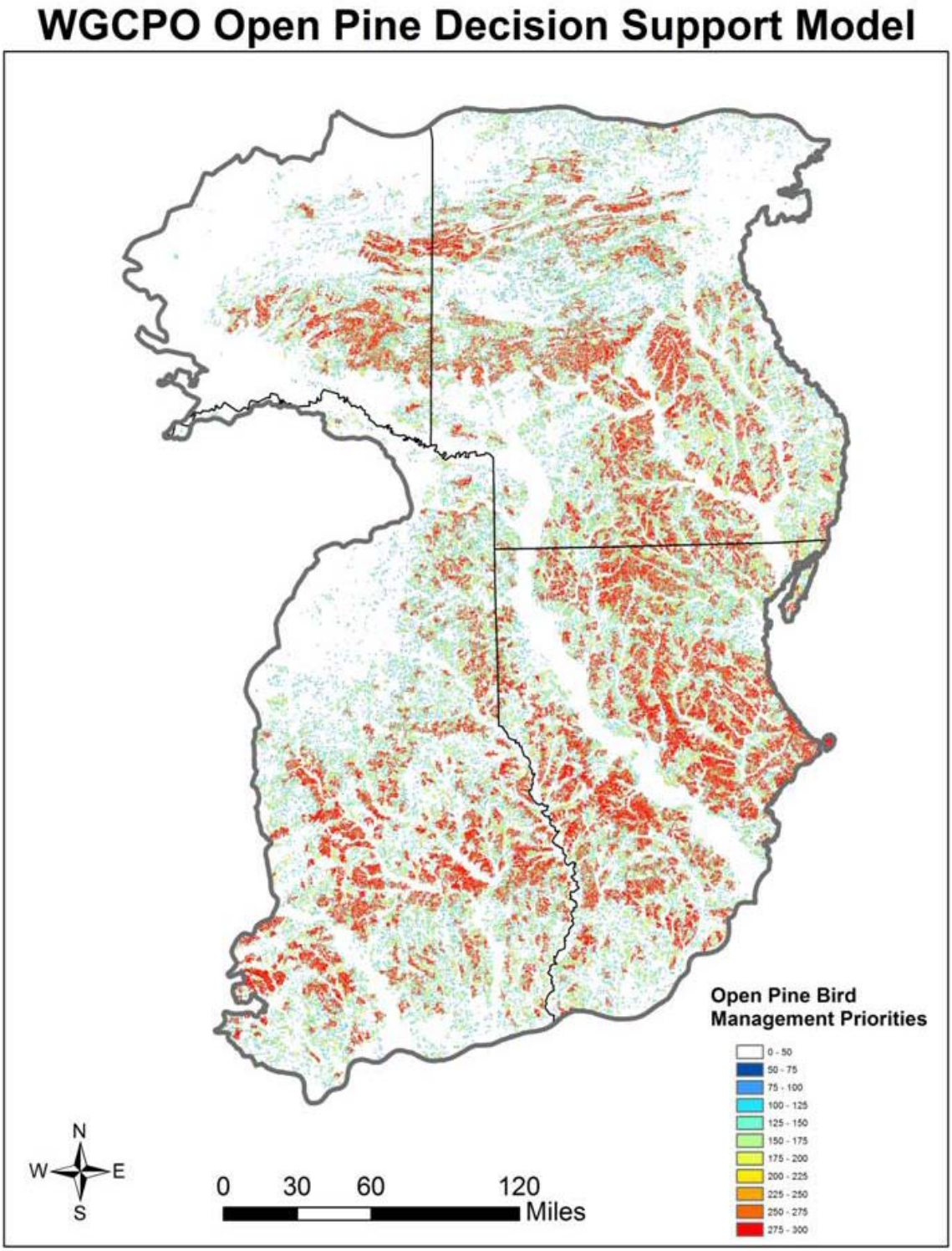
1. Conducted patch analysis and removed all patches of forest that could not support at least one pair (Table 9).

2. Buffered (i.e., enlarged) each patch by ½ the dispersal distance for that species (Table 9).
3. When the buffer of a patch intersected the buffer of another patch, we assume proximity permitted exchange of breeding individuals (i.e., dispersal) among patches.
4. Performed a patch analysis on the buffered areas of the original patches to identify suitably interconnected patches (i.e., patches among which dispersal was likely).
5. Analyzed each cluster of interconnected patches to determine total area of potential habitat.
    - Exclusive of any patches of habitat incapable of supporting a breeding pair.
6. Clusters of interconnected patches that contained sufficient potential habitat to support a minimum viable population (MVP) were designated as such and all the patches in the cluster were identified as potential targets for open pine management.
7. The individual patches (forest habitat) inside the clusters identified above were then ranked based on their capability (ha) to support a MVP. Such that for each species, values ranged from a minimum of the area required to support one pair (RCWO=50, BHNU=3, BACS=3 ha) to a maximum of the area required to support one MVP (RCWO=1000, BHNU=84, BACS=150)
    - Patches that were large enough to support more than one MVP were given a value of the area required to support one MVP for that species. This gave all patches large enough to support at least one MVP the same priority in the model.
8. The ranked values of the patches were then normalized to change the units from hectares to % of MVP for each species. This was done by dividing the values (ha) by the area required to support an MVP for that species.
    - This resulted in values ranging from 0% (non habitat or not enough habitat to support one pair) to 100% (enough habitat to support 100% or more of an MVP) for each individual species model.
9. We combined the 3 individual species models by summing these percentages such that the final output ranged from 0 (not able to contribute to the support of any species) and 300 (able, with management, to contribute to the support of an MVP for all 3 umbrella species).

Table 9. Demographic parameters for the four umbrella species used to develop decision support tool targeting appropriate management of pine and mixed pine-hardwood forest based on 2001 National Land Cover depiction of these habitats.

Species	Density (ha/pair)	Minimum viable population (no. of pair)	Area of suitable habitat required (ha)	Dispersal potential (km)
Red-cockaded woodpecker	50	20	1,000	8
Northern bobwhite	6.8	60	408	1.8
Brown-headed nuthatch	3.5	28	99	0.92
Bachman's sparrow	3	50	150	3

Figure 10. Three-species (Bachman's sparrow, Brown-headed nuthatch, red-cockaded woodpecker) decision support model depicting priorities for management of open pine habitat for priority bird species in the West Gulf Coastal Plains/Ouachitas Bird Conservation Region.



MONITORING

Population and habitat objectives are based on numerous assumptions regarding life history parameters and bird-habitat relationships. These assumptions, as stated herein, must be evaluated. Ultimately, measuring the conservation community's success in achieving the biological objectives for birds of open pine habitat will be possible only through monitoring bird populations and their response to management actions.

Assessment of population goals for northern bobwhite, brown-headed nuthatch, and Bachman's sparrow rely on continued monitoring via BBS routes within the WGCPO. Towards that end, we advocate continuance of this monitoring program. Assessment of trends from these data will provide a useful measure of progress toward short-term population goals. However, evaluation of mid-term and long-term population goals requires reliable, quantifiable estimates of avian populations. Such estimates are not possible using existing BBS protocols. Therefore, we encourage all BBS volunteers to record time (within 1 minute intervals) and distance (within 2 categories [<50m and ≥50]) of first detection for each bird detected (Farnsworth et al. 2005). These data will allow statistical estimation of the probability of detecting a species when it is present, and concurrently allow estimation of the effective distance (radius) within which each species can be detected.

We recommend continued demographic monitoring follow the protocols outlined in Appendix 2 of the Red-cockaded Woodpecker Recovery Plan 2nd Revision (nestling banding, group checks) for red-cockaded woodpecker groups on federal and state lands. We encourage private landowners to follow the same protocols as federal and state red-cockaded woodpecker populations where time and funds allow.

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