

# EFFECTS OF PRESCRIBED FIRE AND MIDSTORY REMOVAL ON BREEDING BIRD COMMUNITIES IN MIXED PINE-HARDWOOD ECOSYSTEMS OF SOUTHERN MISSISSIPPI

Loren W. Burger, Jr.

Department of Wildlife & Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762

Carol Hardy<sup>1</sup>

U.S. Department of Agriculture, Forest Service, Box 9690, Mississippi State University, Mississippi State, MS 39762

Jeff Bein

U.S. Department of Agriculture, Forest Service, Route 1, Box 1, Meadville, MS 39653

## ABSTRACT

Fire has been an integral mechanism in the formation, evolution, and maintenance of southeastern pine ecosystems. The natural fire regime, determined, in part, the species composition in mixed pine-hardwood forests typical of the upper and lower coastal plain of the southeastern United States. Historically, prescribed fire has been essential in managing and maintaining pine and pine-hardwood forest ecosystems. Reduced frequency, intensity, and extent of fire have changed ground cover, understory, and midstory plant species composition and structure in forest lands of the southeastern coastal plain. Subsequently, loss of pine-grassland habitats contributed to widespread declines in populations of fire-adapted vertebrate species. Recently, management priorities and practices on > 800,000 hectares of U.S. Forest Service land in the Southeast have changed to facilitate restoration of the endangered red-cockaded woodpecker (*Picoides borealis*) (RCW) and the pine-grassland ecosystem to which it is adapted. The RCW is a pyric-adapted species and many changes in Forest Service management relate to fire regimes. Traditional prescribed fire regimes on Forest Service lands involved dormant season fire on a 3–6 year frequency. Management regimes to enhance RCW habitat quality reduce and control hardwood mid- and understory and therefore involve mechanical removal of hardwoods, shorter fire rotations (2–3 years), and greater use of growing season burns. We evaluated effects of RCW habitat management practices on breeding bird communities in Homochitto National Forest in southwestern Mississippi. In 1995 we conducted point counts in mature pine and pine-hardwood forest stands under traditional ( $n=38$ ) and RCW ( $n=40$ ) prescribed management regimes. Stands under RCW prescriptions exhibited greater total breeding bird abundance (12.9 versus 10.6 birds/point,  $P = 0.005$ ) and marginally greater species richness (9.8 versus 8.9 species/point,  $P = 0.08$ ) than stands under traditional management. Nine species were more abundant in stands under RCW prescription, versus four species which were more abundant in stands under traditional management. Those species favored under RCW prescriptions tended to be early successional or mature pine-grassland species that are declining regionally or nationally (7 of 9), whereas those species favored under traditional management were relatively common forest interior species exhibiting stable or increasing trends (4 of 4 species). Prescribed fire regimes that maintain open pine-grassland forest structure likely enhance both alpha and beta diversity by promoting regionally scarce habitats to which numerous southeastern bird species are adapted.

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## INTRODUCTION

Fire has been an integral mechanism in the formation, evolution, and maintenance of southeastern pine ecosystems (Robbins and Myers 1992). On an evolutionary time scale, the fire regime, that is the frequency, intensity, and timing of natural fires, determined, in part, the species composition and pine-hardwood ratio in mixed pine-hardwood forests typical of the upper and lower coastal plain of the southeastern United States. Historically, prescribed fire has been an essential tool used in managing and maintaining pine

and pine-hardwood forest ecosystems throughout the Southeast (Robbins and Myers 1992). However, because of effective public relations efforts concerning wildfire and increasingly restrictive legislation, frequency and extent of prescribed burning have diminished throughout the South in recent decades. Prescribed burning by public land management agencies, such as the U.S. Forest Service, has similarly been curtailed by restrictive regulations intended to enhance public safety and minimize smoke and fire liability. Pine-grassland systems such as the longleaf (*Pinus palustris*)-wiregrass (*Aristida berenichium*), longleaf-bluestem (*Andropogon spp.*), and longleaf-shortleaf (*Pinus echinata*)-loblolly (*Pinus taeda*)-bluestem associations depend on fire to control hardwood invasion

<sup>1</sup> Present address: Tall Timbers Research Station, North Carolina Sandhills Study, P.O. Box 326, Hoffman, NC 28347-0326.

and maintain a grass-forb ground cover. Reducing the frequency, intensity, and extent of fire results in a dense hardwood midstory and eventual replacement of open pine-grasslands with closed canopy mixed pine-hardwood forests (Engstrom et al. 1984, Wilson et al. 1995). Fire exclusion results in dramatic changes in plant species composition and subsequent changes in vertebrate species composition (Engstrom et al. 1984, Engstrom 1993). Loss of pine-grassland habitat has contributed, in part, to widespread declines in populations of vertebrate species such as red-cockaded woodpeckers (*Picoides borealis*), Bachman's sparrow (*Aimophila aestivalis*), northern bobwhite (*Colinus virginianus*), gopher tortoise (*Gopherus polyphemus*), and indigo snake (*Drymarchon corais couperi*) (Engstrom et al. 1996).

Recently, management priorities and practices on > 800,000 hectares of Forest Service land in the Southeast have been realigned to facilitate restoration of the federally endangered red-cockaded woodpecker and the pine-grassland ecosystem to which it is adapted (USDA Forest Service 1995). The RCW is a pyric-adapted species and many of the changes in Forest Service management relate to fire regimes (USDA Forest Service 1995). Traditional prescribed fire regimes on many Forest Service lands involved dormant season fire on a 3–6 year rotation. Prescribed fire regimes intended to enhance RCW habitat quality are designed to reduce and control hardwood mid- and understory and therefore involve shorter rotations (2–3 years) and greater use of growing season burns (USDA Forest Service 1995). Mechanical removal is frequently used to initially reduce hardwood midstory, followed by frequent prescribed fire to maintain hardwood control and stimulate grass-forb ground cover (USDA Forest Service 1995). The forest management operations and fire regime associated with RCW habitat management substantially alter the ground, understory, and midstory plant species composition and structure (Cooper 1996). However, effects of management practices intended to enhance RCW habitat on other vertebrate species are poorly documented (Brennan et al. 1994).

Lucas (1993) reported that RCW habitat management practices affected the occurrence and abundance of certain breeding bird species in pine flatwoods and upper coastal plain forests of Mississippi. However, the magnitude of this effect varied with management intensity and practices. Wilson et al. (1995) reported that in Arkansas, hardwood midstory removal and subsequent burning reduced densities of species that require hardwood-dominated habitats, but forest edge species and pine-grassland species benefitted from these practices. Brennan et al. (1994) illustrated the lack of comprehensive efforts to document the effects of RCW habitat management on nontarget species and highlighted the need to study vertebrate community response to RCW habitat management in various pine-dominated ecosystems and geographic regions. Therefore, we evaluated breeding bird abundance and species richness in mature pine and pine-hardwood forests under RCW and traditional management in the lower

coastal plain of southwestern Mississippi. Specifically, we tested the hypotheses that total breeding bird abundance, abundance of individual species, and species richness did not differ between mature pine stands under traditional and RCW habitat management regimes.

## STUDY AREA AND METHODS

We monitored breeding bird communities in mature (saw timber >35 years old) pine and pine-hardwood stands under two different management regimes (traditional and RCW habitat) on Homochitto National Forest in southwestern Mississippi. The Homochitto National Forest encompasses 76,378 hectares of upland pine, pine-hardwood, and bottomland forest. This forest lies in the lower coastal plain physiographic region and the presettlement vegetation association has been described as longleaf pine-shortleaf pine-loblolly pine-hardwood transition area (Frost 1993). The forest is characterized by mixed longleaf pine-shortleaf pine-loblolly pine on xeric ridges merging into loblolly pine-hardwood on the lower slopes and mixed hardwoods in the drainages. Topography is rolling to steeply broken. Pine stands on the Homochitto contain no more than 29% hardwood in the main canopy. The pine component is comprised of approximately 70% loblolly, 25% shortleaf, and 5% longleaf on a forest-wide basis. Xeric sites have a greater proportion of shortleaf and longleaf. Loblolly proportion increases with site moisture. Most pine stands on Homochitto are either 1–30 or 60–80 years of age due to previous timber harvest practices. Virtually all of Homochitto National Forest was clear-cut approximately 75 years ago. Extant mature pine stands on Homochitto are regeneration from these timber harvests which occurred prior to acquisition by the Forest Service. The mean age of mature stands is approximately 75 years. Pine basal area ranges from 13.8–27.6 square meters per hectare with a mean of 17.2 square meters per hectare. Hardwood basal areas in pine stands range from 2.3–4.6 square meters per hectare in predominately intermediate, suppressed, and midstory stems with occasional canopy trees. Pine-hardwood stands contain 30–50% hardwood and 51–69% pine in the main canopy. Pine composition and age was similar to that of pine stands.

On Homochitto National Forest, traditional and RCW habitat management regimes differ primarily in hardwood midstory removal and prescribed burn frequency. During the 5 years preceding our study, most 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.

We randomly selected 40 stands of mature pine or pine-hardwood in each of the 2 management regimes. Stands were delineated based on forest type, stand age, management history, and Forest Service planning records. Stands in each management regime were of similar mean age and canopy composition (pine or pine-

hardwood). Mean number of growing seasons since the previous fire and number of prescribed burns during the 8 years preceding our study were 1.4 and 2.5, respectively, for RCW stands and 4.3 and 1, respectively, for stands under traditional management. Within each stand we randomly located one bird census point > 100 meters from an edge. Points were permanently marked with monument signs. We conducted standardized 5-minute, fixed radius point counts (Ralph 1993, Ralph et al. 1993). Each point was visited once between 15 May and 15 June, 1995. Point counts were completed within the first 4 hours after sunrise. We identified species and recorded all individuals seen or heard within 50 meters of plot center. Points were > 250 meters apart and thus were treated as independent observations in a completely randomized design.

We present relative abundance for each species as mean number of birds per point. Additionally, we determined mean total bird abundance per point and mean species richness per point. We further classified species by habitat associations (forest interior, forest edge, open-pine-shrub-grassland) and nesting guilds (ground-shrub, cavity, canopy) to examine patterns of response among groups of species using similar habitats (Hamel 1992, Wilson et al. 1995). We used T-tests to compare mean total number of birds per point, relative abundance of each species per point, and species richness per point (number of species detected) between stands under traditional and RCW management regimes. Clearly, effects of fire regime and hardwood midstory removal are confounded in this design, therefore we cannot attribute differences in avian community composition or abundance to either fire regime or midstory removal alone. We restrict all inferences to overall effects of "RCW habitat management" versus traditional management regimes. Additionally, we did not randomly assign treatments to stands, but instead, randomly sampled stands from among those under existing forest service management regimes (RCW or traditional). Thus, we conducted an observational study or mensurative experiment as opposed to a manipulative experiment (Eberhardt and Thomas 1991).

## RESULTS

We selected 40 stands under each of the two management regimes; however, two points in stands under traditional management were excluded from analysis because they were altered by southern pine beetle control operations. We detected 38 species in stands under traditional management and 39 species in stands under RCW habitat management (Table 1). Mean total abundance was greater ( $t = 2.9$ ,  $df = 76$ ,  $P = 0.005$ ) in stands under RCW management ( $\bar{x} = 12.9$ ) than in those under traditional management ( $\bar{x} = 10.6$ ). Mean species richness per point was marginally greater ( $t = 1.75$ ,  $df = 76$ ,  $P = 0.08$ ) in RCW ( $\bar{x} = 9.8$ ) than traditionally managed stands ( $\bar{x} = 8.9$ ). Nine species, including white-eyed vireo (*Vireo griseus*), common yellowthroat (*Geothlypis trichas*), yellow-breasted chat (*Icteria virens*), rufous-sided towhee (*Pipilo erythro-*

*phthalmus*), prairie warbler (*Dendroica discolor*), indigo bunting (*Passerina cyanea*), red-cockaded woodpecker, brown-headed nuthatch (*Sitta pusilla*), and eastern wood-pewee (*Contopus virens*) were more abundant ( $P < 0.05$ ) in stands under RCW habitat management. Four species including tufted titmouse (*Parus bicolor*), acadian flycatcher (*Empidonax virens*), blue-gray gnatcatcher (*Polioptila caerulea*), and red-eyed vireo (*Vireo olivaceus*) were more abundant ( $P < 0.05$ ) in stands under traditional management.

## DISCUSSION

Management strategies that enhance RCW habitat quality are designed to reduce hardwood mid- and understory vegetation and create an open pine-grassland forest structure using mechanical hardwood midstory removal and short rotation prescribed fire (USDA Forest Service 1995). Under intensive RCW habitat management, these practices reduce hardwood midstory cover and basal area and dramatically increase herbaceous cover and height (Wilson et al. 1995, Cooper 1996). These changes in plant species composition and structure result in corresponding changes in avian community composition and abundance (Lucas 1993, Wilson et al. 1995).

On Homochitto National Forest, we observed greater total breeding bird abundance and species richness in stands under RCW habitat management than in similar-aged stands under traditional management. We observed that white-eyed vireo, common yellowthroat, yellow-breasted chat, rufous-sided towhee, prairie warbler, indigo bunting, red-cockaded woodpecker, brown-headed nuthatch, and eastern wood-pewee were more abundant in stands under RCW habitat management. In Arkansas, Wilson et al. (1995) similarly observed that brown-headed nuthatch, indigo bunting, eastern wood-pewee, and prairie warbler were more abundant in stands managed to enhance RCW habitat quality than in control stands. Likewise, Lucas (1993) reported that on Noxubee National Wildlife Refuge in central Mississippi, brown-headed nuthatch, common yellowthroat, eastern wood-pewee, red-cockaded woodpecker, yellow-breasted chat, rufous-sided towhee, and indigo bunting were more abundant in stands intensively managed for RCWs. Wilson et al. (1995) suggested that species such as the red-cockaded woodpecker, brown-headed nuthatch, and eastern wood-pewee prefer the open, parklike structure created by intensive RCW habitat. In old field-loblolly pine habitats in northern Florida, bird species that nested in ground cover or foraged in the open cease to inhabit stands within a few years after fire exclusion (Engstrom et al. 1984, Engstrom 1993). Insofar as RCW habitat management opens the understory and stimulates herbaceous ground cover (Cooper 1996), habitat quality for ground nesting and open foraging species is likely enhanced. Wilson et al. (1995) reported that response of species associated with the shrub layer (i.e., indigo bunting and prairie warbler) was dependent on woody vegetation response to fire and time since fire. They reported indigo bunting abundance

Table 1. Relative breeding bird populations in relation to red-cockaded woodpecker (RCW) habitat management in pine and pine-hardwood stands in Homochitto National Forest, Mississippi. May–June 1995.

Habitat preferences, nesting guilds, species	Treatment				P
	Traditional		RCW		
	$\bar{x}$	SE	$\bar{x}$	SE	
Forest interior					
Ground-shrub nesters					
Wood thrush <i>Hylocichla mustelina</i>	0.45	0.11	0.35	0.08	0.485
Black-and-white warbler <i>Mniotilta varia</i>	0.00	0.00	0.03	0.03	0.333
Worm-eating warbler <i>Helminthos vermivorus</i>	0.16	0.06	0.08	0.04	0.262
Swainson's warbler <i>Limnithlypis swainsonii</i>	0.08	0.06	0.00	0.00	0.168
Hooded warbler <i>Wilsonia citrina</i>	0.61	0.11	0.38	0.11	0.135
Cavity nesters					
Red-bellied woodpecker <i>Melanerpes carolinus</i>	0.82	0.12	0.68	0.13	0.429
Downy woodpecker <i>Picoides pubescens</i>	0.00	0.00	0.05	0.03	0.167
Hairy woodpecker <i>Picoides villosus</i>	0.03	0.03	0.08	0.05	0.430
Pileated woodpecker <i>Dryocopus pileatus</i>	0.16	0.07	0.08	0.04	0.319
Great-crested flycatcher <i>Myiarchus crinitus</i>	0.26	0.08	0.28	0.60	0.291
Carolina chickadee <i>Parus carolinensis</i>	0.21	0.08	0.20	0.52	0.603
Tufted titmouse <i>Parus bicolor</i>	0.58	0.10	0.20	0.07	0.002*
Canopy nesters					
Broad-winged hawk <i>Buteo platypterus</i>	0.03	0.03	0.00	0.00	0.308
Red-shouldered hawk <i>Buteo lineatus</i>	0.03	0.03	0.00	0.00	0.308
Yellow-billed cuckoo <i>Coccyzus americanus</i>	0.37	0.10	0.28	0.11	0.532
Ruby-throated hummingbird <i>Archilochus colubris</i>	0.00	0.00	0.03	0.03	0.333
Acadian flycatcher <i>Empidonax virescens</i>	0.63	0.10	0.10	0.05	0.0001*
Blue-gray gnatcatcher <i>Poliophtila caerulea</i>	0.37	0.12	0.08	0.04	0.021*
Yellow-throated vireo <i>Vireo flavifrons</i>	0.13	0.07	0.08	0.04	0.478
Red-eyed vireo <i>Vireo olivaceus</i>	1.08	0.10	0.35	0.08	0.00001*
Northern parula warbler <i>Parula americana</i>	0.03	0.03	0.00	0.00	0.308
American redstart <i>Setophaga ruticilla</i>	0.08	0.04	0.00	0.00	0.071
Summer tanager <i>Piranga rubra</i>	0.55	0.10	0.55	0.68	0.986
Forest edge					
Ground-shrub nesters					
Mourning dove <i>Zenaida macroura</i>	0.08	0.04	0.18	0.08	0.294
Carolina wren <i>Thryothorus ludovicianus</i>	0.55	0.11	0.83	0.15	0.147
Brown thrasher <i>Toxostoma rufum</i>	0.03	0.03	0.00	0.00	0.308
White-eyed vireo <i>Vireo griseus</i>	0.13	0.06	0.48	0.12	0.011*
Common yellowthroat <i>Geothlypis trichas</i>	0.00	0.00	0.33	0.09	0.001*
Yellow-breasted chat <i>Icteria virens</i>	0.24	0.07	1.08	0.13	0.0001*

Table 1. Continued.

Habitat preferences, nesting guilds, species	Treatment				P
	Traditional		RCW		
	$\bar{x}$	SE	$\bar{x}$	SE	
Northern cardinal <i>Cardinalis cardinalis</i>	0.84	0.14	0.70	0.12	0.429
Rufous-sided towhee <i>Pipilo erythrophthalmus</i>	0.05	0.04	0.23	0.08	0.046*
Brown-headed cowbird <i>Molothrus ater</i>	0.00	0.00	0.05	0.03	0.167
Cavity nesters					
Yellow-shafted flicker <i>Colaptes auratus</i>	0.05	0.04	0.18	0.07	0.130
Carolina wren <i>Thryothorus ludovicianus</i>	0.55	0.11	0.83	0.15	0.147
Canopy nesters					
Mourning dove <i>Zenaida macroura</i>	0.08	0.04	0.18	0.08	0.294
Eastern kingbird <i>Tyrannus tyrannus</i>	0.00	0.00	0.05	0.05	0.333
Blue jay <i>Cyanocitta cristata</i>	0.37	0.11	0.48	0.12	0.523
American crow <i>Corvus brachyrhynchos</i>	0.26	0.11	0.55	0.16	0.139
Open Pine-Grassland					
Ground-shrub nesters					
Northern bobwhite <i>Colinus virginianus</i>	0.26	0.10	0.25	0.09	0.922
Prairie warbler <i>Dendroica discolor</i>	0.05	0.04	0.58	0.12	0.0001*
Indigo bunting <i>Passerina cyanea</i>	0.11	0.05	0.50	0.11	0.002*
Bachman's sparrow <i>Aimophila aestivalis</i>	0.03	0.03	0.18	0.08	0.081
Cavity nesters					
Red-headed woodpecker <i>Melanerpes erythrocephalus</i>	0.11	0.05	0.25	0.08	0.124
Red-cockaded woodpecker <i>Picoides borealis</i>	0.00	0.00	0.43	0.13	0.002*
Brown-headed nuthatch <i>Sitta pusilla</i>	0.05	0.04	0.45	0.15	0.012*
Canopy nesters					
Red-tailed hawk <i>Buteo jamaicensis</i>	0.00	0.00	0.03	0.03	0.333
Eastern wood-pewee <i>Contopus virens</i>	0.16	0.06	0.43	0.08	0.009*
Pine warbler <i>Dendroica pinus</i>	0.63	0.10	0.88	0.11	0.108

peaking 3 years postfire and prairie warbler abundance increasing with time since fire. Cooper (1996) reported that RCW habitat management actually increased shrub cover due to stump sprouting following shearing and burning. In our study, bird species such as indigo bunting, prairie warbler, yellow-breasted chats, common yellowthroats, and rufous sided towhees likely responded to similar changes in shrub layer.

Conversely, management practices intended to enhance RCW habitat quality seemed to negatively affect abundance of tufted titmouse, acadian flycatcher, blue-gray gnatcatcher, and red-eyed vireo. This is partially consistent with observations on Noxubee National Wildlife Refuge where Lucas (1993) reported that red-eyed vireos were marginally more abundant in unmanaged stands. However, she observed greater abun-

dance of blue-gray gnatcatchers in stands managed for RCWs.

Of the 12 species showing similar densities under both management regimes, 8, including wood thrush (*Hylocichla mustelina*), red-bellied woodpecker (*Melanerpes carolinus*), hairy woodpecker (*Picoides villosus*), great-crested flycatcher (*Myiarchus crinitus*), Carolina chickadee (*Parus carolinensis*), yellow-billed cuckoo (*Coccyzus americanus*), yellow-throated vireo (*Vireo flavifrons*), summer tanager (*Piranga rubra*) are considered to favor forest interior habitat conditions (Hamel 1992). However, Hamel (1992) indicates that several of these species (wood thrush, great-crested flycatcher, yellow-throated vireo, summer tanager) favor more open wooded conditions with a well-developed understory. Wilson et. al. (1995) stated

that many midstory and bole foragers persisted in RCW-treated stands when scattered hardwoods were present. In stands under RCW management on Homochitto National Forest some codominant hardwoods and understory soft- and hardmast producing hardwoods have been retained to provide habitat for a diversity of species. In addition, wide streamside zones bordering upland pine stands have been retained and prescribed fire is allowed to naturally sort out the hardwood component. These actions, in the context of ecosystem management principles, might explain the continued presence of these forest interior species.

Those species exhibiting greater relative abundance in stands under RCW management were most frequently ground and shrub nesters characteristic of forest edge, or open pine-shrub-grassland habitats. The response of this group of nontarget species is particularly relevant because many early successional bird species are exhibiting regional or national declines (Church et al. 1993). In fact, among species monitored by the U.S. Fish and Wildlife Breeding Bird Survey, grassland bird species show the most consistent decline of any habitat association group (Sauer et al. 1996). Seven of nine species (brown-headed nuthatch, eastern wood-pewee, indigo bunting, prairie warbler, rufous-sided towhee, common yellowthroat, and red-cockaded woodpecker) that exhibited greater abundance in stands under RCW habitat management also exhibited regional and national declines (Sauer et al. 1996); whereas, all species that were more abundant in traditionally managed stands were stable or increasing regionally or nationally.

Although RCW management guidelines have been developed based on the habitat needs of a single species, implementing these practices contributes to restoring southern, fire-maintained pine-grassland ecosystems. Consequently, RCW habitat management actually constitutes "ecosystem management" or "restoration" from which many early successional, fire-adapted species such as RCWs, Bachman's sparrow, prairie warbler, and northern bobwhite likely benefit (Brennan 1991, Lucas 1993, Wilson et al. 1995). Prescribed fire regimes, such as those implemented under RCW habitat management, maintain open pine-grassland forest structure and contribute to enhancing both alpha and beta diversity by promoting regionally scarce habitats to which numerous southeastern bird species are adapted.

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Appendix 1. Scientific names of birds mentioned in text.

Common name	Scientific name
Broad-winged hawk	<i>Buteo platypterus</i>
Red-shouldered hawk	<i>Buteo lineatus</i>
Red-tailed hawk	<i>Buteo jamaicensis</i>
Northern bobwhite	<i>Colinus virginianus</i>
Mourning dove	<i>Zenaida macroura</i>
Yellow-billed cuckoo	<i>Coccyzus americanus</i>
Ruby-throated hummingbird	<i>Archilochus colubris</i>
Red-bellied woodpecker	<i>Melanerpes carolinus</i>
Downy woodpecker	<i>Picoides pubescens</i>
Hairy woodpecker	<i>Picoides villosus</i>
Red-cockaded woodpecker	<i>Picoides borealis</i>
Northern flicker	<i>Colaptes auratus</i>
Pileated woodpecker	<i>Dryocopus pileatus</i>
Eastern wood-pewee	<i>Contopus virens</i>
Acadian flycatcher	<i>Empidonax vireescens</i>
Great crested flycatcher	<i>Myiarchus crinitus</i>
Eastern kingbird	<i>Tyrannus tyrannus</i>
Blue jay	<i>Cyanocitta cristata</i>
American crow	<i>Corvus brachyrhynchos</i>
Carolina chickadee	<i>Parus carolinensis</i>
Tufted titmouse	<i>Parus bicolor</i>
Brown-headed nuthatch	<i>Sitta pusilla</i>
Carolina wren	<i>Thryothorus ludovicianus</i>
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>
Wood thrush	<i>Hylocichla mustelina</i>
Brown thrasher	<i>Toxostoma rufum</i>
White-eyed vireo	<i>Vireo griseus</i>
Yellow-throated vireo	<i>Vireo flavifrons</i>
Red-eyed vireo	<i>Vireo olivaceus</i>
Northern parula warbler	<i>Parula americana</i>
Pine warbler	<i>Dendroica pinus</i>
Prairie warbler	<i>Dendroica discolor</i>
Black-and-white warbler	<i>Mniotilta varia</i>
American redstart	<i>Setophaga ruticilla</i>
Worm-eating warbler	<i>Helmitheros vermivorus</i>
Swainson's warbler	<i>Limnithlypis swainsonii</i>
Common yellowthroat	<i>Geothlypis trichas</i>
Hooded warbler	<i>Wilsonia citrina</i>
Yellow-throated chat	<i>Icteria virens</i>
Summer tanager	<i>Piranga rubra</i>
Northern cardinal	<i>Cardinalis cardinalis</i>
Indigo bunting	<i>Passerina cyanea</i>
Rufous-sided towhee	<i>Pipilo erythrophthalmus</i>
Bachman's sparrow	<i>Aimophila aestivalis</i>
Brown-headed cowbird	<i>Molothrus ater</i>