



Bird Monitoring at Pea Ridge National Military Park, Arkansas

Status Report

Natural Resource Technical Report NPS/HTLN/NRTR—2013/725



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Bird habitat at Pea Ridge National Military Park

Photograph courtesy of Heartland Inventory and Monitoring Network

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Executive Summary

In 2008, the Heartland I&M Network (HTLN) initiated breeding bird surveys on Pea Ridge National Military Park (PERI), Arkansas to address two objectives. The first was to monitor changes in bird community composition and abundance. Secondly, we monitored the responses of bird communities to changes in habitat structure and other habitat variables related to management activities. This report evaluates trends in the park's breeding bird populations in the context of trends observed within the North American Bird Conservation Initiative's (NABCI) Central Hardwoods Bird Conservation Region, the bird conservation region in which the park is located. By doing so, we can assess the influence of habitat management on the park on bird populations with an understanding of what population trends are doing regionally, outside the influence of PERI natural resource management activities.

One hundred and one species of birds were recorded during May-June site visits in the five years since initiating monitoring. Eighty-six of the species are considered breeding species because they are permanent or summer residents. Twenty-four of the breeding species recorded on PERI are species of concern for the Central Hardwoods Bird Conservation Region. Sixteen species recorded on PERI (including four of regional concern) show negative 5-year population trends, while their 45-year regional trends have been positive. However, 12 species (including four of regional concern) have positive recent trends on the park while their 45-year regional trends have been negative.

Results of our most recent bird surveys (2012) are similar to previous years and show the Summer Tanager was the most commonly occurring and wide spread species on PERI. The Tufted Titmouse, Blue-gray Gnatcatcher, Indigo Bunting, and Northern Cardinal were the next most abundant species, in that order. After the Summer Tanager; Blue-gray Gnatcatcher, Indigo Bunting, and Eastern Wood-pewee were the next most widely distributed species on the park. All three were distributed equally across plot surveyed. With 25% of the park in a grassland habitat type, three breeding grassland obligate species were recorded, the Dickcissel, Eastern Meadowlark, and Grasshopper Sparrow. No woodland obligates were reported on the park.

This report provides current regional and local trends for breeding birds for future comparisons with bird data collected as part of the long-term monitoring efforts at PERI. With this report, park staff will be able to better plan management objectives and assess the effectiveness of management alternatives. Monitoring data also provides park staff with additional information useful for interpreting natural resources.

Acknowledgments

We would like to thank the staff of Pea Ridge National Military Park, Arkansas for allowing us access to the memorial during our site visits. We would also like to thank park staff and volunteers: Candice S. Canady, Gregg J. Wolcott, Vicky A. Olson, Nolan W. Moore, J. Mitch Cockrill, Lorraine Heartfield, and Steve P. Munch who assisted with bird surveys on the park.

Introduction

Birds are an important component of park ecosystems, as their high body temperature, rapid metabolism, and high ecological position in most food webs make them good indicators of the effects of local and regional changes in ecosystems. It has been suggested that management activities aimed at preserving habitat for bird populations, such as neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Moreover, birds have a tremendous following among the public and many parks provide information on the status and trends of birds through their interpretive programs.

Pea Ridge National Military Park (PERI), Arkansas is located in the western edge of the Ozark Highland section of the Central Hardwoods Bird Conservation Region (Figure 1). The Central Hardwoods Bird Conservation Region is one of 67 regions identified in the North American Bird Conservation Initiative (NABCI). Started in 1999, the NABCI is a coalition of government agencies and private organizations in the United States working to ensure the long-term health of North America's native bird populations (NABCI 2012).

Topography of the area in and around PERI is dissected, with local relief over 100 meters common (Fitzgerald and Pashley 2000). However, broad flat ridges can be found throughout. The landscape historically contained a habitat of oak-hickory forest with a prairie grass understory in ravines and grass savanna habitat on ridges. Approximately, 122 species of breeding birds can be found in the habitat of the area (Stokes and Stokes 1996). Widespread habitat loss to agriculture, as well as urban and industrial development, threaten the integrity of the area for birds.

Data collected during the U.S. Geological Survey's annual North American Breeding Bird Surveys (BBS) between 1966 and 2010 indicate that a number of bird species with potential to occur at PERI show evidence of population decline (Sauer et al. 2011). In fact, 45% of the species have populations reported to be in decline with species such as the Grasshopper Sparrow (*Ammodramus savannarum*), House Sparrow (*Passer domesticus*), Lark Sparrow (*Chondestes grammacus*), Loggerhead Shrike (*Lanius ludovicianus*), Northern Bobwhite (*Colinus virginianus*), and Yellow-billed Cuckoo (*Coccyzus americanus*) declining at alarming rates.

Long-term trends in community composition and abundance of breeding bird populations provide one measure for assessing the ecological integrity and sustainability of this system. We will use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity on their habitat found at PERI. *Ecosystem integrity* is defined as the system's capability to support and maintain a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that of the natural habitats of the region (Karr and Dudley 1981). Research has demonstrated that birds serve as good indicators of changes in ecosystems (Cairns et al. 2004, Mallory et al. 2006, Wood et al. 2006). Therefore, changes in the numbers and composition of bird communities may reflect the effectiveness of management in restoring and maintaining bird habitat at PERI.

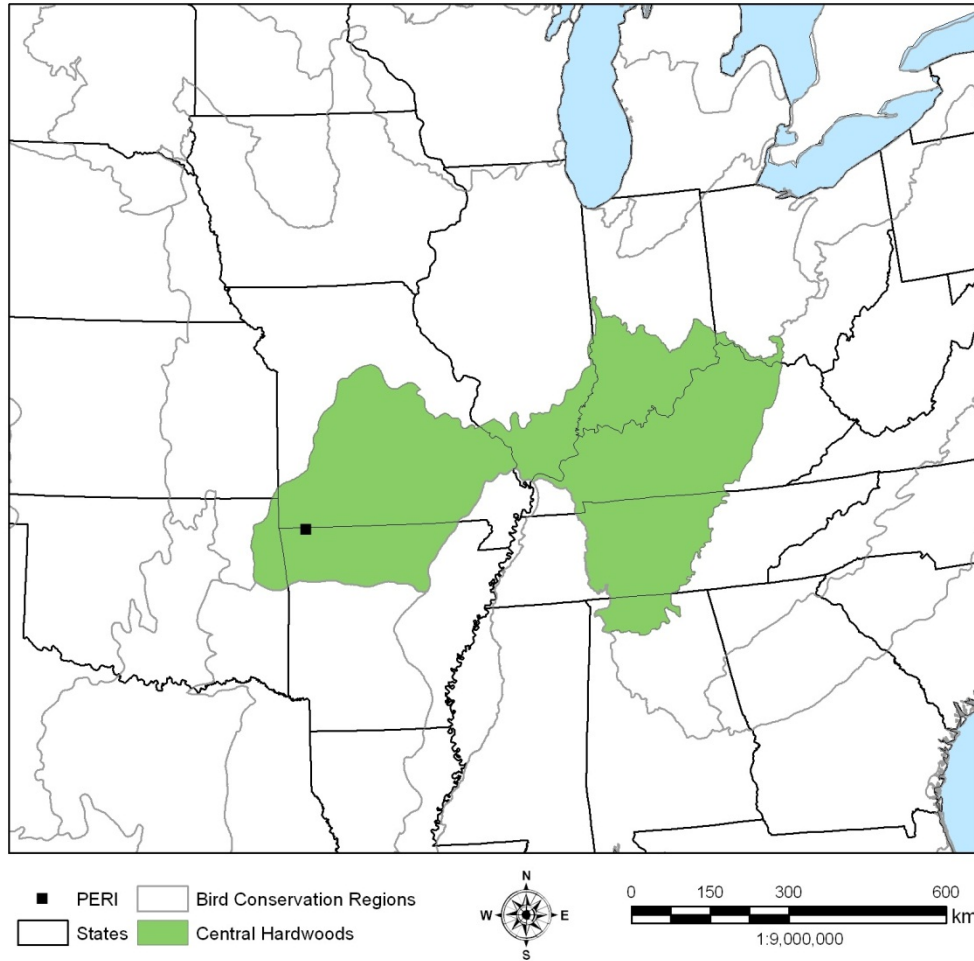


Figure 1. Location of Pea Ridge National Military Park (PERI), Arkansas within the Central Hardwoods Bird Conservation Region.

Objectives

There are two primary objectives for monitoring breeding birds at Pea Ridge National Military Park:

- Identify significant temporal changes in the species composition and abundance of bird communities that occur at PERI during the breeding season.
- Improve our understanding of breeding bird – habitat relationships and the effects of management actions such as stand thinning or prescribed fire on bird populations, by correlating changes in bird community composition and abundance with changes in specific habitat variables (e.g., vegetation structure, ground cover).

As a first step in meeting monitoring objectives, this report summarizes population trends for birds recorded during the first five years of monitoring. A more comprehensive report on habitats found within the park is forthcoming and should be consulted when making habitat management decisions (James and Peitz, in review).

Methods

Site Selection

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 400 x 400 meter cells (originating from a random start point). The orientation of the grid was rotated 45 degrees to prevent monitoring sites from being influenced by man-made features (roads, fences, etc.) located along cardinal directions. We established 99 permanent plots: 24 in grassland/open habitat and 75 in woodland habitat. Monitoring occurred on the majority of the 99 sites across years (Table 1).

Table 1. Number of plots sampled, and sampling dates for breeding bird surveys conducted at Pea Ridge National Military Park, Arkansas, by year. Also listed are observer(s) who conducted the surveys and whether or not habitat data was collected during the survey year.

Year	Sampling Dates	Number of Plots Sampled	Observer(s)	Habitat Data Collected
2008	May 12 – May 18	99	D.G. Peitz*	Yes
2009	May 20 – July 1	97	Candice S. Canady, Gregg J. Wolcott, Vicky A. Olson, and Nolan W. Moore	No
2010	May 11 – June 4	36	J. Mitch Cockrill, Lorraine Heartfield, and Steve P. Munch	No
2011	No Surveys were conducted			
2012	May 14 – May 23	98	D.G. Peitz*	Yes

*Heartland I&M Network staff.

During bird surveys in 2008 and 2012, monitoring plots were located using navigation waypoints (Peitz et al. 2009) in a Trimble Geo XT GPS unit and temporarily marked with 36-inch pin flags to aid in re-locating the plots for habitat assessment, eliminating the need for permanent plot markers. We collected pin flags from each plot once the habitat work was completed. During

bird surveys in 2009 and 2010, years when habitat assessments were not conducted, monitoring plots were located using a GPS unit. However, plot locations were not marked with pin flags.

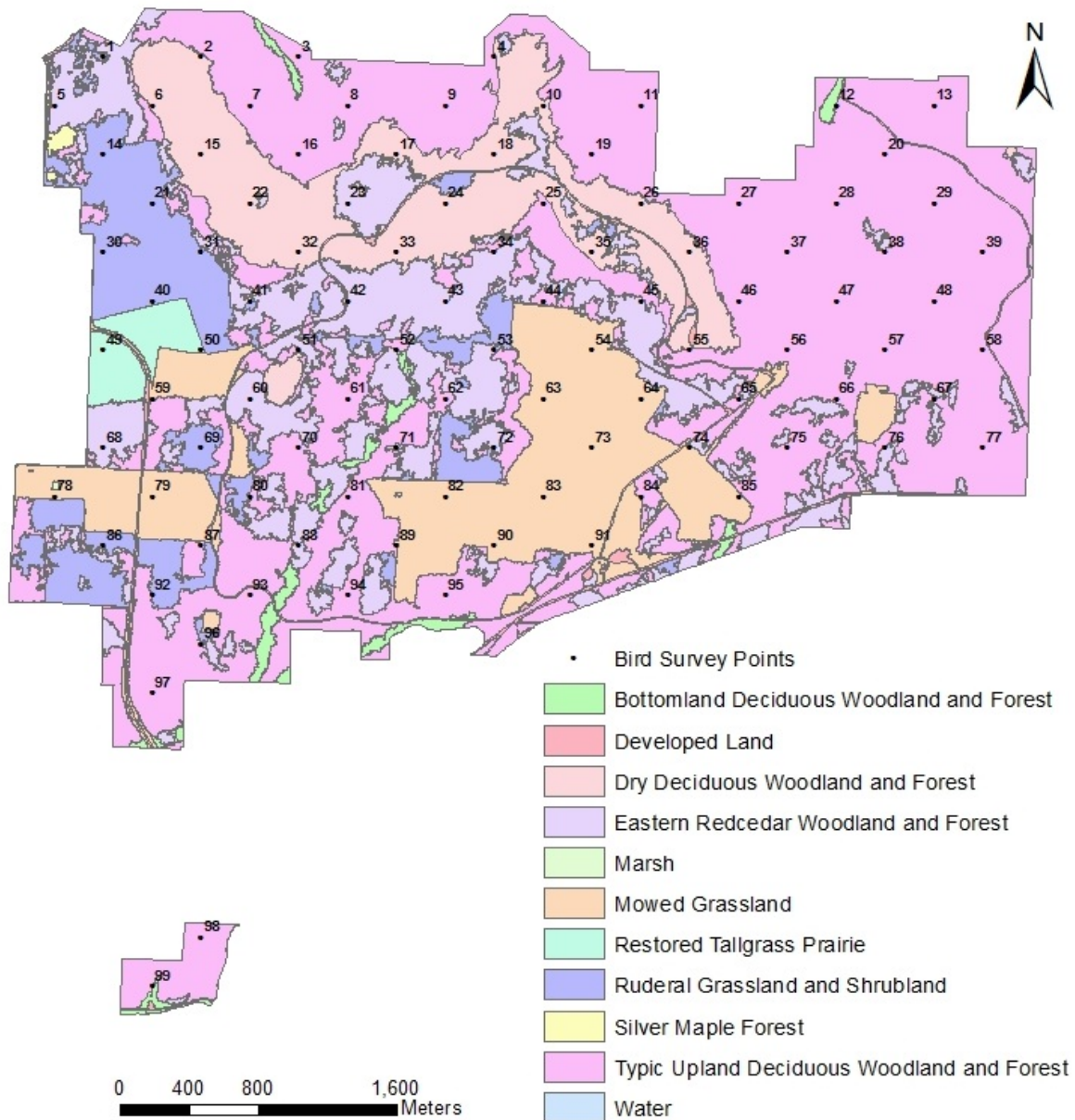


Figure 2. Bird plot locations on Pea Ridge National Military Park, Arkansas. Vegetation mapping and classification provided by Diamond et.al. (in press).

Bird Surveys

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized below. Variable circular plot counts, a point count methodology that incorporates a measure of detectability into population estimates, were used to survey birds present (Fancy 1997). All birds seen or heard at plots during 5-min sampling periods were recorded along with

their corresponding distance from observer. Bird observations were separated into two time segments: those detected during the first three minutes of the count (to allow for comprehensive comparisons with the national Breeding Bird Survey data), and any new birds detected during the final two minutes of the count. For most species, we recorded each individual bird as a separate observation. For species that usually occur in clusters or flocks, the units recorded were cluster or flock size, and not the individual bird. During analysis, each individual in a cluster or flock was treated as a separate observation. After completing a count at a plot and filling out the data sheet, the observer navigated to the next plot using a GPS unit. While travelling between plots, the observer was vigilant for the presence of species not recorded during timed surveys. These species help formulate a more complete species list for the park by identifying species missed during timed surveys. We sampled birds during a period when it was light enough to observe birds to four hours after sunrise.

Variable circular plot counts were conducted in an attempt to get an “instantaneous count” of all birds present. The observer recorded birds flushed from a plot when approached and the counts were started as soon as the observer reached plot center. We recorded all birds seen or heard, including flyovers, along with distance from the observer when possible. For this report, all birds seen or heard during the full 5-min are included. Birds recorded from a previous plot were noted and excluded from analysis.

Data Analysis

Prior to summary analysis, the residency status (migrant, permanent resident, summer resident, transient, winter resident) of each bird species recorded was determined. Identifying the residency of each species helps to exclude migrants, transients, and winter residents from analysis of breeding birds within PERI. Population trend estimates, expressed as a percent change per year, is the simplest measures of population changes over a time period. For this report, we obtained regional breeding bird trends for the Central Hardwoods Bird Conservation Region during two periods, 1966-2010 and 1999-2010 (Sauer et al. 2011). We then compare trends seen in the bird populations at PERI with these trends. The proportion of plots occupied by each species annually was determined (total number of plots occupied by a species/plots surveyed) and used in calculating trends based on average percent annual change. Population trends on PERI are reported as increasing, decreasing, or stable based on the direction of percent annual change. The frequency and abundance of bird species recorded in 2012 were reported (Appendix 1), using the proportion of plots occupied by each species, and for each species, the number of individuals encountered per plot visit (individuals/plot visit).

Results

Bird Surveys

Between years 2008-2010, and year 2012, 36 to 99 plots on PERI were surveyed yearly for breeding birds (Table 1). During this five year period, 330 plots were surveyed, and 101 different bird species were recorded, 86 of which are species with the potential to breed within the park (Table 2; James and Neal 1986). Six breeding species, Baltimore Oriole (*Icterus galbula*), Black-billed Cuckoo (*Coccyzus erythrophthalmus*), Broad-winged Hawk (*Buteo platypterus*), Chimney Swift (*Chaetura pelagica*), Cliff Swallow (*Petrochelidon pyrrhonota*), and Tree Swallow (*Tachycineta bicolor*), were only observed outside 5-min survey periods. American Tree Sparrow (*Spizella arborea*) and Sharp-shinned Hawk (*Accipiter striatus*), winter residents, were also recorded outside 5-min survey periods. Twenty-four of the breeding species recorded are considered species of regional concern for the Central Hardwoods Bird Conservation Region (CHBCR 2012).

Table 2. Bird species recorded during breeding bird surveys at Pea Ridge National Military Park, Arkansas in 2008 through 2010, and 2012. The American Ornithologists' Union Code (AOU code) and residency status of each species is given.

Common name	Species name	AOU code	Residency ¹
Acadian Flycatcher	<i>Empidonax virescens</i>	ACFL	SR
American Crow	<i>Corvus brachyrhynchos</i>	AMCR	R
American Goldfinch	<i>Carduelis tristis</i>	AMGO	R
American Redstart	<i>Setophaga ruticilla</i>	AMRE	SR
American Robin	<i>Turdus migratorius</i>	AMRO	R
American Tree Sparrow*	<i>Spizella arborea</i>	ATSP	WR
American Woodcock	<i>Scolopax minor</i>	AMWO	R
Baltimore Oriole*	<i>Icterus galbula</i>	BAOR	SR
Barn Swallow	<i>Hirundo rustica</i>	BARS	SR
Barred Owl	<i>Strix varia</i>	BDOW	R
Bewick's Wren	<i>Thryomanes bewickii</i>	BEWR	R
Black-and-white Warbler	<i>Mniotilta varia</i>	BAWW	SR
Black-billed Cuckoo*	<i>Coccyzus erythrophthalmus</i>	BBCU	SR
Black Vulture	<i>Coragyps atratus</i>	BLVU	R
Blue Jay	<i>Cyanocitta cristata</i>	BLJA	R
Blue-gray Gnatcatcher	<i>Poliophtila caerulea</i>	BGGN	SR
Blue Grosbeak	<i>Passerina caerulea</i>	BLGR	SR
Blue-winged Warbler	<i>Vermivora pinus</i>	BWWA	SR
Bobolink	<i>Dolichonyx oryzivorus</i>	BOBO	T
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>	BRBL	WR
Broad-winged Hawk*	<i>Buteo platypterus</i>	BWHA	SR
Brown Creeper	<i>Certhia americana</i>	BRCR	WR
Brown-headed Cowbird	<i>Molothrus ater</i>	BHCO	R
Brown Thrasher	<i>Toxostoma rufum</i>	BRTH	R
Carolina Chickadee	<i>Parus carolinensis</i>	CACH	R

Table 2. Bird species recorded during breeding bird surveys at Pea Ridge National Military Park, Arkansas in 2008 through 2010, and 2012. The American Ornithologists' Union Code (AOU code) and residency status of each species is given. (continued)

Common name	Species name	AOU code	Residency ¹
Carolina Wren	<i>Thryothorus ludovicianus</i>	CARW	R
Cedar Waxwing	<i>Bombycilla cedrorum</i>	CEDW	M
Chestnut-sided Warbler	<i>Dendroica pensylvanica</i>	CSWA	M
Chimney Swift*	<i>Chaetura pelagica</i>	CHSW	SR
Chipping Sparrow	<i>Spizella passerine</i>	CHSP	SR
Cliff Swallow*	<i>Petrochelidon pyrrhonota</i>	CLSW	SR
Common Grackle	<i>Quiscalus quiscula</i>	COGR	R
Common Yellowthroat	<i>Geothlypis trichas</i>	COYE	SR
Dickcissel	<i>Spiza americana</i>	DICK	SR
Downy Woodpecker	<i>Picoides pubescens</i>	DOWO	R
Eastern Bluebird	<i>Sialia sialis</i>	EABL	R
Eastern Kingbird	<i>Tyrannus tyrannus</i>	EAKI	SR
Eastern Meadowlark	<i>Sturnella magna</i>	EAME	R
Eastern Phoebe	<i>Sayornis phoebe</i>	EAPH	R
Eastern Towhee	<i>Pipilo erythrophthalmus</i>	EATO	R
Eastern Wood-pewee	<i>Contopus virens</i>	EAWP	SR
European Starling	<i>Sturnus vulgaris</i>	EUST	R
Field Sparrow	<i>Spizella pusilla</i>	FISP	R
Fish Crow	<i>Corvus ossifragus</i>	FICR	SR
Grasshopper Sparrow	<i>Ammodramus savannarum</i>	GRSP	SR
Gray Catbird	<i>Dumetella carolinensis</i>	GRCA	SR
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	GCFL	SR
Great Horned Owl	<i>Bubo virginianus</i>	GHOW	R
Hairy Woodpecker	<i>Picoides villosus</i>	HAWO	R
Henslow's Sparrow	<i>Ammodramus henslowii</i>	HESP	T
Hermit Thrush	<i>Catharus guttatus</i>	HETH	WR
Horned Lark	<i>Eremophila alpestris</i>	HOLA	R
House Sparrow	<i>Passer domesticus</i>	HOSP	R
Indigo Bunting	<i>Passerina cyanea</i>	INBU	SR
Kentucky Warbler	<i>Oporornis formosus</i>	KEWA	SR
Killdeer	<i>Charadrius vociferus</i>	KILL	R
Lark Sparrow	<i>Chondestes grammacus</i>	LASP	SR
Louisiana Waterthrush	<i>Seiurus motacilla</i>	LOWA	SR
Mourning Dove	<i>Zenaida macroura</i>	MODO	R
Northern Bobwhite	<i>Colinus virginianus</i>	NOBO	R
Northern Cardinal	<i>Cardinalis cardinalis</i>	NOCA	R
Northern Flicker	<i>Colaptes auratus</i>	YSFL	R
Northern Mockingbird	<i>Minus polyglottos</i>	NOMO	R
Northern Parula	<i>Parula americana</i>	NOPA	SR
Orchard Oriole	<i>Icterus spurius</i>	OROR	SR
Ovenbird	<i>Seiurus aurocapillus</i>	OVEN	SR
Pileated Woodpecker	<i>Dryocopus pileatus</i>	PIWO	R

Table 2. Bird species recorded during breeding bird surveys at Pea Ridge National Military Park, Arkansas in 2008 through 2010, and 2012. The American Ornithologists' Union Code (AOU code) and residency status of each species is given. (continued)

Common name	Species name	AOU code	Residency ¹
Prairie Warbler	<i>Dendroica discolor</i>	PRAW	SR
Red-bellied Woodpecker	<i>Melanerpes carolinus</i>	RBWO	R
Red-eyed Vireo	<i>Vireo olivaceus</i>	REVI	SR
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	RHWO	R
Red-shouldered Hawk	<i>Buteo lineatus</i>	RSHA	R
Red-tailed Hawk	<i>Buteo jamaicensis</i>	RTHA	R
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	RWBL	R
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	RTHU	SR
Scarlet Tanager	<i>Piranga olivacea</i>	SCTA	SR
Scissor-tailed Flycatcher	<i>Tyrannus forficatus</i>	STFL	SR
Sharp-shinned Hawk*	<i>Accipiter striatus</i>	SSHA	WR
Song Sparrow	<i>Melospiza melodia</i>	SOSP	WR
Sora	<i>Porzana carolina</i>	SORA	M
Summer Tanager	<i>Piranga rubra</i>	SUTA	SR
Swainson's Thrush	<i>Catharus ustulatus</i>	SWTH	T
Tree Swallow*	<i>Tachycineta bicolor</i>	TRES	SR
Tufted Titmouse	<i>Baeolophus bicolor</i>	ETTI	R
Turkey Vulture	<i>Cathartes aura</i>	TUVU	R
Veery	<i>Catharus fuscescens</i>	VEER	T
Warbling Vireo	<i>Vireo gilvus</i>	WAVI	SR
Whip-poor-will	<i>Caprimulgus vociferous</i>	WPWI	SR
White-breasted Nuthatch	<i>Sitta carolinensis</i>	WBNU	R
White-eyed Vireo	<i>Vireo griseus</i>	WEVI	SR
Wild Turkey	<i>Meleagris gallopavo</i>	WITU	R
Willow Flycatcher	<i>Empidonax traillii</i>	WIFL	SR
Wood Thrush	<i>Hylocichla mustelina</i>	WOTH	SR
Worm-eating Warbler	<i>Helminthos vermivorus</i>	WEWA	SR
Yellow Warbler	<i>Dendroica petechia</i>	YWAR	SR
Yellow-bellied Sapsucker	<i>Sphyrapicus varius</i>	YBSA	WR
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	YBCU	SR
Yellow-breasted Chat	<i>Icteria virens</i>	YBCH	SR
Yellow-rumped Warbler	<i>Dendroica coronata</i>	MYWA	WR
Yellow-throated Vireo	<i>Vireo flavifrons</i>	YTVI	SR
Yellow-throated Warbler	<i>Dendroica dominica</i>	YTTA	SR

* Species recorded only while traveling between point transects or at other times outside of 5-min survey periods.

¹ Residency: M = migrant; R = year around resident; SR = summer resident; T = transient; WR = winter resident; According to James and Neal (1986).

Species names are valid and verified names taken from the Integrated Taxonomic Information System web site (ITIS 2012).

Bolded species names are those species considered of regional concern for the Central Hardwoods Bird Conservation Region (CHBCR 2012).

Thirty-nine breeding species on PERI, or 45% have shown negative population trends within the larger Central Hardwoods Bird Conservation Region between 1966 and 2010 (45 years; Table 3). And between 2000 and 2010 (11 years) this number increased to 46 species, or 53% of all the breeding species recorded. During our 5-years of monitoring, 34 of the breeding species (40%) recorded on PERI have shown negative population trends on the park. This equates to 13% (1966-2010 estimates) and 26% (1999-2010 estimates) fewer birds on PERI showing more declines than at the regional scale. However, we were unable to calculate trends on the six species recorded outside the 5-min survey periods. Fifteen additional species showed neither a positive nor negative population trend. Therefore, negative population trends locally may be as much as 46% and 20% higher than the 45-year and 11-year regional trends, respectively. Differences in both population trends and their magnitude between the park and regional scales may in all likelihood be the result of our short sampling period (5 years).

Sixteen species recorded on PERI – Acadian Flycatcher (*Empidonax virescens*), American Goldfinch (*Caruelis tristis*), American Redstart (*Setophaga ruticilla*), American Robin (*Turdus migratorius*), Black-and-white Warbler (*Mniotilta varia*), Blue-gray Gnatcatcher (*Poliophtila caerulea*), Carolina Wren (*Thryothorus ludovicianus*), Kentucky Warbler (*Oporornis formosus*), Louisiana Waterthrush (*Seiurus motacilla*), Northern Parula (*Parula americana*), Pileated Woodpecker (*Dryocopus pileatus*), Summer Tanager (*Piranga rubra*), Tufted Titmouse (*Baeolophus bicolor*), White-eyed Vireo (*Vireo griseus*), Worm-eating Warbler (*Helmitheros vermivorus*), and Yellow-Throated Vireo (*Vireo flavifrons*) - show negative population trends, while their 45 year regional trends have been positive (Table 3). Four of these species - Blue-gray Gnatcatcher, Kentucky Warbler, White-eyed Vireo, and Worm-eating Warbler are species of regional concern for the Central Hardwoods Bird Conservation Region. However, 12 species showing negative population trends in the region – Blue Jay (*Cyanocitta cristata*), Carolina Chickadee (*Parus carolinensis*), Downy Woodpecker (*Picoides pubescens*), Eastern Kingbird (*Tyrannus tyrannus*), Great Crested Flycatcher (*Myiarchus crinitus*), Great Horned Owl (*Bubo virginianus*), Mourning Dove (*Zenaida macroura*), Northern Bobwhite (*Colinus virginianus*), Northern Cardinal (*Cardinalis cardinalis*), Northern Flicker (*Colaptes auratus*), Red-winged Blackbird (*Agelaius phoeniceus*), and Yellow-billed Cuckoo (*Coccyzus americanus*) - have positive trends at the park. Four of these species – Eastern Kingbird, Northern Bobwhite, Northern Flicker, and Yellow-billed Cuckoo are species of concern for the Central Hardwoods Bird Conservation Region.

During our most recent bird surveys (2012), the Summer Tanager was the most commonly occurring and widespread species at PERI based on the mean number of individuals per plot and the proportion of plots occupied (Appendix 1). The Tufted Titmouse, Blue-gray Gnatcatcher, Indigo Bunting, and Northern Cardinal were the next most abundant species, respectively. After the Summer Tanager; Blue-gray Gnatcatcher, Indigo Bunting, and Eastern Wood-pewee were the next most widely distributed species at the park. All three were distributed equally across plots surveyed.

Table 3. Trends in breeding birds recorded on Pea Ridge National Military Park (PERI), Arkansas, and the Central Hardwoods Bird Conservation Region for comparison.

Common name	Region				PERI
	1966 – 2010		2000 - 2010		2008 - 2012
	Trend	95% CI	Trend	95% CI	Trend
Acadian Flycatcher	0.3	-0.3, 0.8	1.7	0.7, 2.8	declining
American Crow	0.3	-0.0, 0.6	-0.7	-1.7, 0.1	increasing
American Goldfinch	1.3	0.8, 1.7	1.2	-0.1, 2.6	declining
American Redstart	0.2	-1.8, 2.4	3.5	-1.8, 10.1	declining
American Robin	1.0	0.6, 1.4	-0.9	-1.8, -0.0	declining
American Woodcock	-1.4	-5.8, 2.5	0.6	-8.2, 11.4	stable
Baltimore Oriole*	1.3	0.6, 2.1	0.4	-1.9, 2.5	increasing
Barn Swallow	-0.8	-1.2, -0.5	-0.6	-1.4, 0.3	declining
Barred Owl	3.1	1.8, 4.6	5.6	1.5, 11.3	stable
Bewick's Wren	-4.7	-6.2, -3.2	-5.7	-12.0, -2.2	declining
Black-and-white Warbler	1.3	-0.0, 2.5	2.8	-0.1, 5.5	declining
Black-billed Cuckoo*	-4.0	-6.2, -1.7	-2.7	-8.7, 2.6	--
Black Vulture	6.5	4.4, 8.5	7.8	0.8, 15.4	increasing
Blue Jay	-1.5	-1.8, -1.2	-1.7	-2.5, -0.9	increasing
Blue-gray Gnatcatcher	0.1	-0.5, 0.7	0.9	-0.3, 2.2	declining
Blue Grosbeak	1.2	0.5, 2.0	1.6	0.2, 3.1	stable
Blue-winged Warbler	0.1	-1.0, 1.2	0.3	-2.6, 3.0	increasing
Brown-headed Cowbird	-0.9	-1.4, -0.5	-0.6	-1.5, 0.4	declining
Brown Thrasher	-1.4	-1.9, -1.0	-1.2	-2.1, -0.2	declining
Carolina Chickadee	-0.4	-1.0, 0.1	-2.4	-3.9, -0.9	increasing
Carolina Wren	2.7	1.5, 3.4	1.5	0.2, 2.9	declining
Chipping Sparrow	1.1	0.7, 1.5	2.2	1.1, 3.3	increasing
Common Grackle	-2.8	-3.2, -2.4	-2.5	-3.4, -1.4	stable
Common Yellowthroat	-1.1	-1.4, -0.8	-1.4	-2.3, -0.6	declining
Dickcissel	-1.0	-2.1, -0.1	-3.0	-5.4, -0.6	stable
Downy Woodpecker	-0.8	-1.3, -0.3	-1.3	-2.9, 0.3	increasing
Eastern Bluebird	0.4	-0.1, 1.0	-1.8	-3.3, -0.2	stable
Eastern Kingbird	-1.3	-1.7, -0.9	-0.9	-1.9, 0.1	increasing
Eastern Meadowlark	-2.2	-2.5, -1.9	-2.3	-3.1, -1.4	declining
Eastern Phoebe	1.4	0.9, 1.9	-0.3	-1.8, 1.0	increasing
Eastern Towhee	-1.4	-1.8, -1.0	-0.3	-1.3, 0.9	declining
Eastern Wood-pewee	-0.5	-0.9, -0.2	-0.5	-1.4, 0.4	declining
European Starling	0.4	-0.1, 0.9	-0.1	-1.6, 1.2	stable
Field Sparrow	-2.2	-2.5, -1.8	-1.6	-2.7, -0.5	declining
Fish Crow*	10.8	7.3, 14.4	12.5	4.6, 20.9	--
Grasshopper Sparrow	-3.6	-4.5, -2.8	-1.3	-3.3, 0.8	declining
Gray Catbird	-2.5	-2.9, -2.1	-2.4	-3.8, -1.0	declining
Great Crested Flycatcher	-1.0	-1.5, -0.5	-0.9	-2.0, 0.1	increasing
Great Horned Owl	-0.5	-2.3, 1.1	-2.1	-7.1, 2.2	increasing

Table 3. Trends in breeding birds recorded on Pea Ridge National Military Park (PERI), Arkansas, and the Central Hardwoods Bird Conservation Region for comparison. (continued)

Common name	Region				PERI
	1966 – 2010		2000 - 2010		2008 - 2012
	Trend	95% CI	Trend	95% CI	Trend
Hairy Woodpecker	0.5	-0.4, 1.3	0.2	-2.5, 2.3	increasing
Horned Lark*	-2.4	-3.5, -1.4	-1.6	-4.6, 0.9	--
House Sparrow	-4.9	-5.4, -4.4	-5.0	-6.3, -3.8	stable
Indigo Bunting	-0.7	-1.0, -0.5	-0.8	-1.4, -0.3	declining
Kentucky Warbler	0.1	-0.5, 0.8	-0.2	-1.9, 1.4	declining
Killdeer	0.5	-0.0, 1.0	-0.8	-2.3, 0.7	stable
Lark Sparrow	-4.7	-6.6, -2.7	-2.9	-7.1, 3.8	stable
Louisiana Waterthrush	2.1	1.0, 3.1	2.8	0.6, 4.9	declining
Mourning Dove	-0.4	-0.7, -0.2	-0.5	-1.2, 0.3	increasing
Northern Bobwhite	-4.0	-4.6, -3.5	-4.9	-6.1, -3.7	increasing
Northern Cardinal	-0.3	-0.5, -0.1	-0.3	-0.8, 0.3	increasing
Northern Flicker	-2.5	-3.0, -2.0	-2.9	-4.5, -1.2	increasing
Northern Mockingbird	-0.4	-0.8, -0.1	-0.5	-1.6, 0.6	declining
Northern Parula	3.0	2.2, 3.8	4.2	2.9, 5.5	declining
Orchard Oriole*	-1.2	-1.6, -0.8	-0.7	-1.8, 0.5	--
Ovenbird	0.9	-0.2, 2.0	2.9	0.7, 5.4	increasing
Pileated Woodpecker	0.3	-0.3, 0.9	0.3	-1.2, 1.7	declining
Prairie Warbler	-2.4	-3.0, -1.8	-2.1	-3.2, -1.0	declining
Red-bellied Woodpecker	0.4	0.0, 0.8	1.8	0.7, 2.8	increasing
Red-eyed Vireo	1.1	0.7, 1.5	1.0	-0.0, 1.9	increasing
Red-headed Woodpecker	-2.6	-3.6, -1.7	-2.7	-5.1, -0.3	stable
Red-shouldered Hawk*	5.1	3.9, 6.2	6.6	4.2, 9.4	--
Red-tailed Hawk	2.0	1.3, 2.7	2.6	0.8, 4.5	increasing
Red-winged Blackbird	-0.8	-1.2, -0.5	-1.0	-2.0, 0.0	increasing
Ruby-throated Hummingbird	2.7	2.0, 3.4	2.6	0.7, 4.4	increasing
Scarlet Tanager	2.0	1.4, 2.6	2.2	0.7, 3.6	stable
Scissor-tailed Flycatcher	6.0	3.9, 7.9	6.4	2.3, 10.9	increasing
Summer Tanager	0.6	0.1, 1.0	0.9	-0.1, 1.9	declining
Tufted Titmouse	0.4	-0.3, 0.9	1.9	0.7, 3.1	declining
Turkey Vulture	3.5	2.7, 4.3	4.2	2.3, 6.5	increasing
Warbling Vireo	1.5	0.9, 2.2	1.0	-0.6, 2.5	stable
Whip-poor-will	-2.2	-3.3, -1.2	-1.9	-4.3, 0.2	declining
White-breasted Nuthatch	2.2	1.3, 3.1	-0.5	-2.7, 1.6	increasing
White-eyed Vireo	0.1	-0.3, 0.5	1.2	0.0, 2.4	declining
Wild Turkey	9.7	7.3, 12.2	14.6	9.3, 20.1	stable
Willow Flycatcher*	1.2	-0.6, 3.0	1.6	-2.3, 6.0	--
Wood Thrush	-0.5	-0.8, -0.1	-0.9	-2.0, 0.2	declining
Worm-eating Warbler	1.5	-0.3, 3.0	1.9	-1.2, 4.3	declining
Yellow Warbler	-1.8	-2.8, -0.9	-1.0	-4.1, 1.9	declining
Yellow-billed Cuckoo	-2.9	-3.6, -2.2	-6.1	-7.8, -4.3	increasing
Yellow-breasted Chat	-1.6	-1.9, -1.2	-0.4	-1.4, 0.6	declining

Table 3. Trends in breeding birds recorded on Pea Ridge National Military Park (PERI), Arkansas, and the Central Hardwoods Bird Conservation Region for comparison. (continued)

Common name	Region				PERI
	1966 – 2010		2000 - 2010		2008 - 2012
	Trend	95% CI	Trend	95% CI	Trend
Yellow-throated Vireo	1.5	0.9, 2.1	2.5	1.2, 4.3	declining
Yellow-throated Warbler	2.9	2.0, 3.8	3.4	1.5, 5.0	stable

* Species recorded between point transects or other times outside of 5-min survey periods.

Bolded species names are those species considered of regional concern for the Central Hardwoods Bird Conservation Region (CHBCR 2012).

Regional trend data from BBS surveys (Sauer et al. 2011).

Discussion

Breeding bird surveys were initiated at PERI in 2008 to assist the park in assessing the integrity of their grasslands and woodlands through time. During the five years of monitoring, 101 bird species have been recorded. Eighty-six are permanent or summer residents to the area (James and Neal 1986). Therefore, these 86 species have some value in characterizing the breeding bird community of PERI, and the habitat on which they rely.

Habitat availability and quality dictates bird population trends within a region. However, when suitable habitat of a sufficient area to meet a species needs is found locally, then local population trends may differ from that of the region. The opposite may be true as well. Identifying regional trends in breeding birds observed on PERI is the first step in assessing the potential effects habitat management for those species might have. For instance, if the prevailing trend in a species regionally is negative, and their numbers are low, then efforts to manage habitat for that species will in all likelihood have little success. However, for species that are regionally common or have populations trending upward, PERI may be able to influence their populations positively through habitat management. Based on local versus regional trends, four species of regional concern recorded on PERI (Eastern Kingbird, Northern Bobwhite, Northern Flicker, and Yellow-billed Cuckoo) and eight additional breeding species have populations that are positively influenced by the current habitat at the park and surrounding area. However, four species of regional concern (Blue-gray Gnatcatcher, Kentucky Warbler, White-eyed Vireo, and Worm-eating Warbler), as well as 12 additional breeding species may be less supported by current habitat on the park and surrounding area than they are by habitat regionally.

Similar to 2008 values reported by Peitz (2009), the Summer Tanager, Tufted Titmouse, Blue-gray Gnatcatcher, Northern Cardinal, and Indigo Bunting are some of the most common and widely distributed species at PERI. Changes in population sizes of the most common and widely distributed species on the park make them good species for assessing changing habitat conditions locally. For example, species like the Northern Cardinal and Indigo Bunting have improved reproductive success when shrub cover is dense and mid-canopy trees are present (Stokes and Stokes 1996). Therefore, a decline in either species' numbers could very well indicate changes in the understory and mid-story of the woodlands or control of woody species in the grasslands. The Indigo Bunting in fact has a local population that is trending downward, which could very well be the results of management efforts to control woody encroachment into the grasslands. Less common and widely distributed species will likely occur so infrequently that strong species-habitat relationships may not be established.

Woodland dominates the bird habitat at PERI 3:1 over grasslands. However, within the Ozark Highlands this mix is nearly 50:50 with woodlands having a slightly greater presence (NPS 2012). For the park, grasslands provide critical habitat for a number of birds and the rich mix of woodland and grassland habitat types, along with the other habitat types present, positively influenced the number of bird species observed. For breeding birds recorded at the park, the only habitat obligate species were the grassland obligates (Dickcissel, Eastern Meadowlark, and Grasshopper Sparrow). The remaining resident species are habitat generalist or edge species, favored by the mix and positioning of habitats at the park. Habitat diversity (structural composition) is especially important for the high priority species, as their microhabitat requirements vary (Pashley and Barrow 1993). For example, Eastern Wood-pewee's prefer open

woodlands and urban/suburban forest, and Kentucky Warblers prefer moist deciduous bottomlands and ravines, but most other species of regional concern require thick shrubby or old field habitat (Stokes and Stokes 1996). The species of regional concern warrant extra scrutiny each time a survey is completed at PERI.

Although the mix of habitats provides potentially satisfactory habitat for all the birds of regional concern as well as most other bird species, this habitat is easily altered if trees are thinned, insect infestations occur, or brushy fields are burned. Our survey data suggest that two species of regional concern (i.e. Blue-gray Gnatcatcher and Eastern Wood-pewee) occur frequently enough at PERI to aid in assessing the influence of habitat management actions on their numbers (Table 3, Appendix 1). Similar to the habitat requirements listed above for the Eastern Wood-pewee and Kentucky Warbler, the habitat requirements for the Blue-gray Gnatcatcher can be identified (i.e. woods, swamps, and shrubby areas, Stokes and Stokes 1996). Habitat management decisions aimed at influencing bird populations should center on those identified as species of regional concern for the Central Hardwoods. However, species common to the park such as the Northern Cardinal need consideration in a broader context of bird conservation when making management decisions.

Conclusions

Since initiating breeding bird surveys on PERI in 2008, HTLN staff and volunteers have surveyed between 36 and 99 plots annually (except 2011), and recorded 101 different species. Eighty-six of the species recorded are permanent or summer residents to the area with the potential to breed within the park. Local and regional population trends from this study indicate that the park appears to have habitat favorable to 12 bird species, but unfavorable to 16. A note of caution is needed here. The limited number of survey years within the park may provide a false trend. However, our reported data is a baseline for placing bird populations at the park into the context of those seen in the larger Central Hardwoods Bird Conservation Region.

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Appendix

Appendix 1. Number of individuals encountered per plot visit, and proportion of 98 plots occupied by breeding bird species at Pea Ridge National Military Park, Arkansas during the 2012 bird surveys. Number of individuals per plot, and proportion of plots occupied include all individuals recorded on plots during a 5-min survey, including flyovers.

Common name	Individuals/plot visit	Proportion of plot occupied
American Crow	0.13	0.08
American Redstart	0.04	0.04
American Robin	0.01	0.01
Barred Owl	0.02	0.02
Black-billed Cuckoo	0.03	0.03
Blue Jay	0.12	0.10
Blue-gray Gnatcatcher	0.41	0.31
Blue Grosbeak	0.03	0.02
Blue-winged Warbler	0.08	0.08
Brown-headed Cowbird	0.08	0.04
Carolina Chickadee	0.08	0.06
Carolina Wren	0.07	0.07
Common Yellowthroat	0.03	0.03
Dickcissel	0.11	0.06
Downy Woodpecker	0.01	0.01
Eastern Bluebird	0.08	0.03
Eastern Kingbird	0.14	0.07
Eastern Meadowlark	0.05	0.04
Eastern Phoebe	0.01	0.01
Eastern Towhee	0.13	0.12
Eastern Wood-pewee	0.31	0.31
European Starling	0.01	0.01
Field Sparrow	0.06	0.05
Fish Crow	0.02	0.01
Grasshopper Sparrow	0.03	0.03
Gray Catbird	0.04	0.04
Great Crested Flycatcher	0.24	0.20
Hairy Woodpecker	0.01	0.01
Horned Lark	0.01	0.01
Indigo Bunting	0.39	0.30
Kentucky Warbler	0.05	0.05
Mourning Dove	0.01	0.01
Northern Bobwhite	0.12	0.08
Northern Cardinal	0.36	0.29
Northern Flicker	0.01	0.01
Northern Mockingbird	0.02	0.02
Northern Parula	0.19	0.19

Appendix 1. Number of individuals encountered per plot visit, and proportion of 98 plots occupied by breeding bird species at Pea Ridge National Military Park, Arkansas during the 2012 bird surveys. Number of individuals per plot, and proportion of plots occupied include all individuals recorded on plots during a 5-min survey, including flyovers. (continued)

Common name	Individuals/plot visit	Proportion of plot occupied
Orchard Oriole	0.02	0.02
Ovenbird	0.01	0.01
Pileated Woodpecker	0.01	0.01
Prairie Warbler	0.07	0.05
Red-bellied Woodpecker	0.13	0.12
Red-eyed Vireo	0.30	0.27
Red-shoulder Hawk	0.01	0.01
Red-tailed Hawk	0.02	0.02
Red-winged Blackbird	0.08	0.01
Ruby-throated Hummingbird	0.01	0.01
Scissor-tailed Flycatcher	0.01	0.01
Summer Tanager	0.50	0.39
Tufted Titmouse	0.42	0.31
White-breasted Nuthatch	0.18	0.17
White-eyed Vireo	0.04	0.04
Wild Turkey	0.01	0.01
Willow Flycatcher	0.05	0.05
Wood Thrush	0.01	0.01
Yellow Warbler	0.02	0.02
Yellow-billed Cuckoo	0.10	0.10
Yellow-breasted Chat	0.07	0.06
Yellow-throated Vireo	0.13	0.11

Bolded species names are those species considered of regional concern for the Central Hardwoods Bird Conservation Region (CHBCR 2012).

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