



# Bird Community Monitoring at Arkansas Post National Memorial, Arkansas

## *Status Report*

Natural Resource Data Series NPS/HTLN/NRDS—2015/997



**ON THE COVER**

Great egret (*Ardea alba*).

Photo taken by Jennifer L. Haack, NPS

---

# **Bird Community Monitoring at Arkansas Post National Memorial, Arkansas**

## *Status Report*

Natural Resource Data Series NPS/HTLN/NRDS—2015/997

David G. Peitz

National Park Service  
The Heartland I&M Network  
Wilson's Creek National Battlefield  
6424 West Farm Road 182,  
Republic, MO 65738

December 2015

U.S. Department of the Interior  
National Park Service  
Natural Resource Stewardship and Science  
Fort Collins, Colorado

The National Park Service, Natural Resource Stewardship and Science office in Fort Collins, Colorado, publishes a range of reports that address natural resource topics. These reports are of interest and applicability to a broad audience in the National Park Service and others in natural resource management, including scientists, conservation and environmental constituencies, and the public.

The Natural Resource Data Series is intended for the timely release of basic data sets and data summaries. Care has been taken to assure accuracy of raw data values, but a thorough analysis and interpretation of the data has not been completed. Consequently, the initial analyses of data in this report are provisional and subject to change.

All manuscripts in the series receive the appropriate level of peer review to ensure that the information is scientifically credible, technically accurate, appropriately written for the intended audience, and designed and published in a professional manner. Data in this report were collected and analyzed using methods based on established, peer-reviewed protocols and were analyzed and interpreted within the guidelines of the protocols.

Views, statements, findings, conclusions, recommendations, and data in this report do not necessarily reflect views and policies of the National Park Service, U.S. Department of the Interior. Mention of trade names or commercial products does not constitute endorsement or recommendation for use by the U.S. Government.

This report is available in digital format from Heartland Inventory and Monitoring Network website (<http://www.nature.nps.gov/im/units/htln/>) and the Natural Resource Publications Management website (<http://www.nature.nps.gov/publications/nrpm/>). To receive this report in a format optimized for screen readers, please email [irma@nps.gov](mailto:irma@nps.gov).

Please cite this publication as:

Peitz, D. G. 2015. Bird community monitoring at Arkansas Post National Memorial, Arkansas: Status report. Natural Resource Data Series NPS/HTLN/NRDS—2015/997. National Park Service, Fort Collins, Colorado.

# Contents

	Page
Figures.....	iv
Tables.....	iv
Appendices.....	iv
Abstract.....	1
Acknowledgment.....	1
Introduction.....	1
Methods.....	4
Site Selection.....	4
Bird Surveys.....	6
Data Analysis.....	6
Results.....	7
Bird Surveys.....	7
Literature Cited.....	11

## Figures

	Page
<b>Figure 1.</b> Location of Arkansas Post National Memorial, Arkansas within the Mississippi Alluvial Valley Bird Conservation Region. ....	3
<b>Figure 2.</b> Bird plot locations on the Memorial and Osotouy units of Arkansas Post National Memorial, Arkansas. ....	5

## Tables

	Page
<b>Table 1.</b> Number of plots sampled, and sampling dates for breeding bird surveys conducted at Arkansas Post National Memorial, Arkansas, by year .....	4
<b>Table 2.</b> Bird species recorded during breeding bird surveys at Arkansas Post National Memorial, Arkansas in 2007, and 2010-2015.....	7

## Appendices

	Page
Appendix A.....	A-1
Appendix B.....	B-1

## **Abstract**

Breeding bird surveys were initiated on Arkansas Post National Memorial (ARPO), Arkansas in 2007 to assess temporal changes in the species composition and abundance of birds on the Memorial, and to improve our understanding of breeding bird – habitat relationships and the effects of management actions such as invasive plant species control and timber stand thinning on bird populations. Birds were sampled using point counts with 36 variable circular plots located on a systematic grid of 200 x 200 meter cells (originating from a random start point). All birds seen or heard on a plot during a 5-min sampling period were recorded. In the nine years since initiating our breeding bird survey, birds have been surveyed on the 36 variable circular plots in seven of those years resulting in 243 plot visits. Surveys have yielded records for 90 different species of birds. Eighty-three of the species recorded are classified as permanent or summer residents to the area, three are classified as migrants through the area, three are classified as winter residents to the area, and one as a transient in the area. Six species recorded are considered species of conservation concern for the Mississippi Alluvial Valley Bird Conservation Region, the bird conservation region ARPO is located within. Twelve of the 83 resident species were recorded on ARPO every year of the surveys.

## **Acknowledgment**

We would like to thank the staff of Arkansas Post National Memorial, Arkansas for allowing us access to the Memorial during our breeding bird surveys and for assisting with bird surveys. We would especially like to thank Ed Wood and Kirby McCallie for their coordination of surveys in years when ARPO was not sampled by HTLN staff, and for conducting many of the surveys

## **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, intended to preserve habitat for bird populations, such as for neotropical migrants, can have the added benefit of preserving entire ecosystems and their attendant ecosystem services (Karr 1991, Maurer 1993). Additionally, the National Park Service plays a role in bird conservation, as it complies with the requirements of the Migratory Bird Treaty Act of 1918 (as amended) and the Executive Order 13186, Responsibilities of Federal Agencies to Protect Migratory Birds. 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. Bird monitoring is also critical as widespread habitat loss to agriculture and urban and industrial development threaten the integrity of the region for birds.

Arkansas Post National Memorial (ARPO), Arkansas is centrally located in the Mississippi Alluvial Valley Bird Conservation Region (Figure 1). The Mississippi Alluvial Valley 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

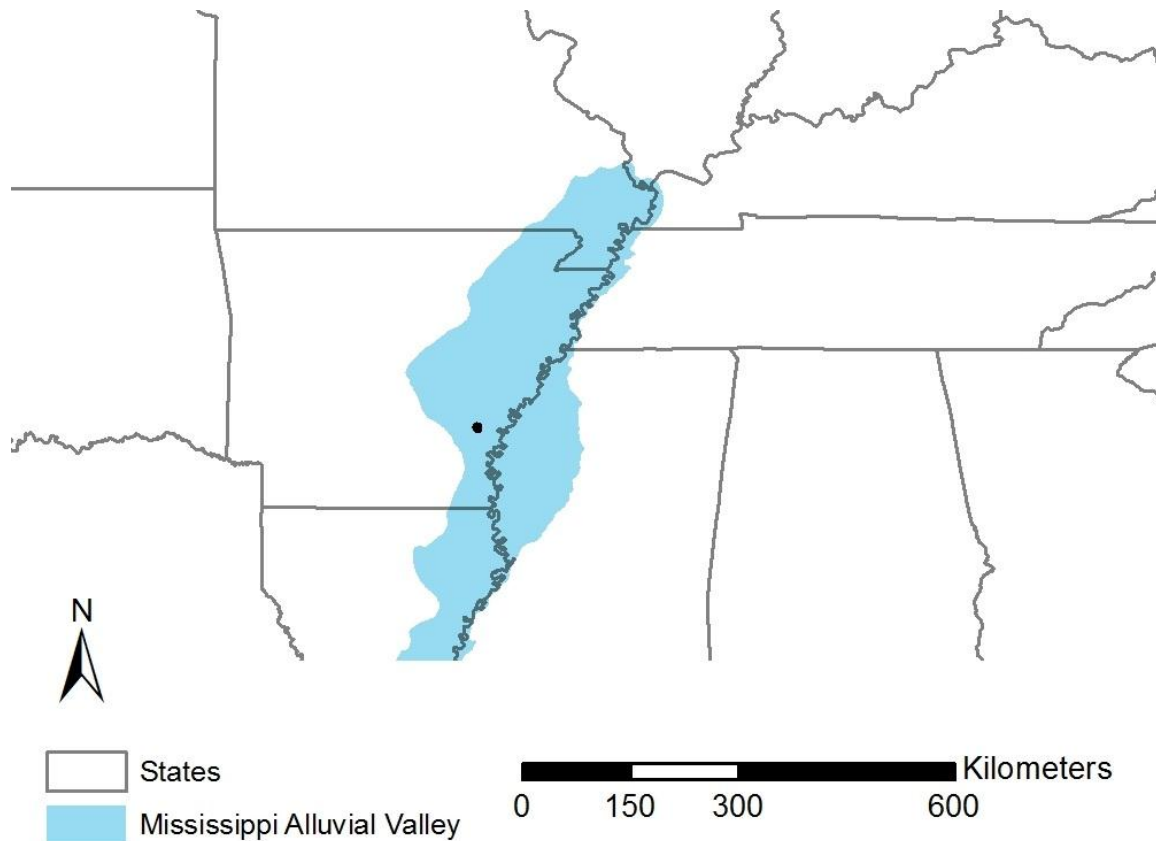
United States working to ensure the long-term health of North America's native bird populations (NABCI 2015).

The Lower Mississippi Alluvial Valley Bird Conservation Region consists of millions of acres of alluvial floodplain south of the Mississippi River's confluence with the Ohio River (NABCI 2015). Historically this was the greatest bottomland hardwood forest on earth and was subject to massive annual flood events of the Mississippi River and its tributaries. Threats to the region include flood control and deforestation for agriculture. Today, less than 25 percent of the region remains forested, and flooding has been reduced by about 90 percent. High priority birds of the region include Least Bittern (*Ixobrychus exilis*), Swallow-tailed Kite (*Elanoides forficatus*), Bald Eagle (*Haliaeetus leucocephalus*), Peregrine Falcon (*Falco peregrinus*), Black Rail (*Laterallus jamaicensis*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Wood Thrush (*Hylocichla mustelina*), Cerulean Warbler (*Dendroica cerulea*), Prothonotary Warbler (*Protonotaria citrea*), Swainson's Warbler (*Limnothlypis swainsonii*), Kentucky Warbler (*Oporornis formosus*), Painted Bunting (*Passerina ciris*), Dickcissel (*Spiza americana*), and Orchard Oriole (*Icterus spurius*; U.S. Fish and Wildlife Service 2008). Approximately 113 species of breeding birds can be found in the habitats of the Lower Mississippi Alluvial Valley around ARPO (James and Neal 1986).

Data collected during the U.S. Geological Survey's annual North American Breeding Bird Surveys (BBS) between 1966 and 2013 indicate that a number of bird species breeding at ARPO show evidence of long-term population decline (Sauer et al. 2014). In fact, 37% of the species have populations reported to be in decline, with species such as the Common Grackle (*Quiscalus quiscula*), Common Yellowthroat (*Geothlypis trichas*), and Northern Bobwhite (*Colinus virginianus*) 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 a system. We will use trends in the composition and abundance of bird populations as long-term indicators of ecosystem integrity at ARPO. *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 result of management actions taken to restore and maintain the cultural landscape at ARPO.





**Figure 1.** Location of Arkansas Post National Memorial, Arkansas within the Mississippi Alluvial Valley Bird Conservation Region.

## Objectives

There are three primary objectives for monitoring breeding birds at Arkansas Post National Memorial:

- Identify significant temporal changes in the species composition and abundance of bird communities that occur at ARPO during the breeding season.
- Improve our understanding of breeding bird – habitat relationships and the effects of management actions such as invasive plant species control and timber stand thinning on bird populations, by correlating changes in bird community composition and abundance with changes in specific habitat variables (e.g., vegetation structure, ground cover).
- Make bird monitoring datasets for ARPO available to the avian conservation community and to the general public through the Avian Knowledge Network (AKN) and Data.Gov through the NPS Integrated Resource Management Applications (IRMA).

As a first step in meeting monitoring objectives, this report summarizes species composition and abundances for birds recorded during the seven years of monitoring.

# Methods

## Site Selection

Permanent monitoring locations or 'plots' were selected by overlaying a systematic grid of 200 x 200 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 36 permanent plots on ARPO for monitoring bird population sizes and community composition (Figure 2). Monitoring occurred on 27 to 36 sites annually depending on year (Table 1).

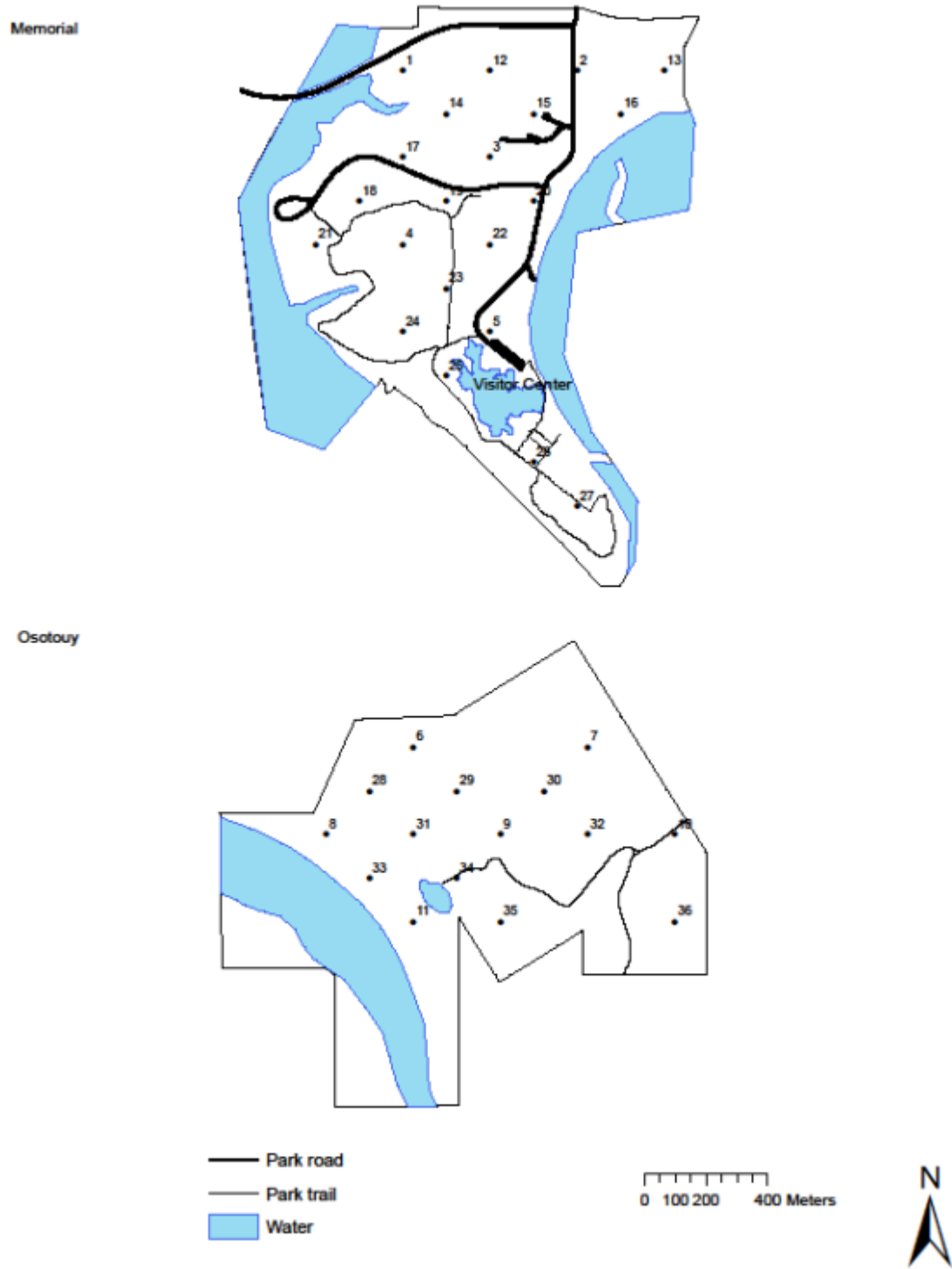
Starting in 2010 the breeding bird monitoring was conducted by ARPO staff, allowing annual data to be collected and HTLN to implement their modified sampling schedule for visiting the Memorial once every fourth year.

Table 1. Number of plots sampled, and sampling dates for breeding bird surveys conducted at Arkansas Post National Memorial, Arkansas, by year. Also listed are observer(s) who conducted the surveys.

Year	Sampling Dates	Number of Plots Sampled	Observer(s)
2007	June 5 – June 7	36	D.G. Peitz*
2010	May 12 – May 19	36	K.N. McCallie, J.B. McCallie, J.A. Allely, S.T. Allely
2011	June 7 – June 8	27	D.G. Peitz*
2012	May 15 – May 17	36	K.N. McCallie, S.T. Allely, C.N. Kolesar
2013	May 28 – May 31	36	K.N. McCallie, E.E. Wood
2014	June 4 – June 8	36	K.N. McCallie, J.B. McCallie, E.E. Wood
2015	May 18 – May 20	36	D.G. Peitz*

\*Heartland I&M Network staff.

During bird surveys in 2007, 2011 and 2015, monitoring plots were located using navigation waypoints (Peitz et al. 2008) in a GPS unit and temporarily marked with 36-inch pin flags to aid in relocating the plots for habitat assessment, eliminating the need for permanent plot markers. Once habitat work is completed we collected pin flags from each plot. During bird surveys in other 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 the Memorial and Osotouy units of Arkansas Post National Memorial, Arkansas.

## **Bird Surveys**

Bird surveys followed methods outlined in the bird monitoring protocol by Peitz et al. (2008) and summarized in this report. 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. 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 traveling 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 Preserve by identifying species missed during timed surveys. However, these observations were not included in any analysis as they did not directly relate to any individual plot. 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 5-min survey are included.

## **Data Analysis**

Prior to summary analysis, the residency status (migrant, permanent resident, summer resident, transient, and 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 ARPO. The proportion of plots occupied by each bird species was calculated (total number of plots occupied by a species/plots surveyed) and reported in Appendix A. Park-wide abundances for each species are reported in Appendix A as well. Park-wide abundance was calculated by first deriving a species density from observations recorded within a 100-m radius (3.14 ha) around each plot center, and then calculating abundance based on the densities found within the area surveyed.

For this report we also obtained regional breeding bird trends for the Mississippi Alluvial Valley Bird Conservation Region during the periods between 2007 and 2013 (Sauer et al. 2014), and reported these values for ARPO in Appendix B for comparison with populations on the park. The period between 2007 and 2013 roughly coincides with our breeding bird monitoring efforts.

# Results

## Bird Surveys

On ARPO breeding bird survey plots have been sampled in seven of the nine year since initiating the study. During years of survey as many of the 36 variable circular plots as possible were sampled resulting in a total of 243 plot visits (Table 1). Ninety bird species were recorded during surveys (Table 2). Eighty-three of the 90 species recorded are classified as permanent or summer residents to the area (James and Neal 1986). Three species--Least Flycatcher (*Empidonax minimus*), Sora (*Porzana carolina*), and Yellow Warbler (*Setophaga petechia*)--are classified as migrants through the area. Three species--Double-crested Cormorant (*Phalacrocorax auritus*), Ruby-crowned Kinglet (*Regulus calendula*), and Song Sparrow (*Melospiza melodia*)--are classified as winter residents to the area. The remaining species, Black-capped Chickadee (*Poecile atricapillus*) is classified as a transient in the area.

On ARPO, six species recorded--Bald Eagle, Dickcissel, Kentucky Warbler, Orchard Oriole, Prothonotary Warbler, Red-headed Woodpecker, and Wood Thrush--are considered species of conservation concern for the Mississippi Alluvial Valley Bird Conservation Region (U.S. Fish and Wildlife Service 2008). Blue-gray Gnatcatcher (*Poliophtila caerulea*), Blue Jay (*Cyanocitta cristata*), Brown-headed Cowbird (*Molothrus ater*), Carolina Wren (*Thryothorus ludovicianus*), Great Egret (*Ardea alba*), Indigo Bunting (*Passerina cyanea*), Morning Dove (*Zenaida macroura*), Northern Cardinal (*Cardinalis cardinalis*), Northern Mockingbird (*Mimus polyglottos*), Red-bellied Woodpecker (*Melanerpes carolinus*), Summer Tanager (*Piranga rubra*), and Tufted Titmouse (*Baeolophus bicolor*) are the most commonly encountered and widely distributed species on ARPO, annually (Appendix A). These 12 species offer the best opportunities for monitoring the influence of changing habitats on bird species. For breeding species recorded on ARPO their trends within the larger Mississippi Alluvial Valley Bird Conservation Region are reported in Appendix B for the period roughly coinciding with the surveys on ARPO.

**Table 2.** Bird species recorded during breeding bird surveys at Arkansas Post National Memorial, Arkansas in 2007, and 2010-2015. Residency status of each species is given.

Common name	Species name	AOU code	Residency <sup>1</sup>
Acadian Flycatcher	<i>Empidonax vireescens</i>	ACFL	SR
American Coot	<i>Fulica americana</i>	AMCO	R
American Crow	<i>Corvus brachyrhynchos</i>	AMCR	R
American Kestrel	<i>Falco sparverius</i>	AMKE	R
American Redstart	<i>Setophaga ruticilla</i>	AMRE	SR
Anhinga	<i>Anhinga anhinga</i>	ANHI	SR
Bachman's Sparrow	<i>Aimophila aestivalis</i>	BACS	R

**Table 2.** (continued)

<b>Common name</b>	<b>Species name</b>	<b>AOU code</b>	<b>Residency<sup>1</sup></b>
Bald Eagle	<i>Haliaeetus leucocephalus</i>	BAEA	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
Black and White Warbler	<i>Nniotilta varia</i>	BAWW	SR
Black-capped Chickadee	<i>Poecile atricapillus</i>	BCCH	T
Black-crowned Night-heron	<i>Nycticorax nycticorax</i>	BCNH	SR
Black Vulture	<i>Coragyps atratus</i>	BLVU	R
Blue-gray Gnatcatcher	<i>Poliopitila caerulea</i>	BGGN	SR
Blue Grosbeak	<i>Passerina caerulea</i>	BLGR	SR
Blue Jay	<i>Cyanocitta cristata</i>	BLJA	R
Brown-headed Cowbird	<i>Molothrus ater</i>	BHCO	R
Brown Thrasher	<i>Toxostoma rufum</i>	BRTH	R
Canada Goose	<i>Branta canadensis</i>	CAGO	R
Carolina Chickadee	<i>Poecile carolinensis</i>	CACH	R
Carolina Wren	<i>Thryothorus ludovicianus</i>	CARW	R
Chimney Swift	<i>Chaetura pelagica</i>	CHSW	SR
Chipping Sparrow	<i>Spizella passerina</i>	CHSP	R
Common Grackle	<i>Quiscalus quiscula</i>	COGR	R
Common Moorhen	<i>Gallinula chloropus</i>	COMO	SR
Common Yellowthroat	<i>Geothlypis trichas</i>	COYE	SR
Dickcissel	<i>Spiza americana</i>	DICK	SR
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	DCCO	WR
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
Fish Crow	<i>Corvus ossifragus</i>	FICR	R
Gray Catbird	<i>Dumetella carolinensis</i>	GRCA	SR
Great Blue Heron	<i>Ardea herodias</i>	GBHE	R

**Table 2.** (continued)

<b>Common name</b>	<b>Species name</b>	<b>AOU code</b>	<b>Residency<sup>1</sup></b>
Great Crested Flycatcher	<i>Myiarchus crinitus</i>	GCFL	SR
Great Egret	<i>Ardea alba</i>	GREG	SR
Grasshopper Sparrow*	<i>Ammodramus savannarum</i>	GRSP	SR
Green Heron*	<i>Butorides virescens</i>	GRHE	SR
Hairy Woodpecker	<i>Picoides villosus</i>	HAWO	R
House Sparrow	<i>Passer domesticus</i>	HOSP	R
House Wren	<i>Troglodytes aedon</i>	HOWR	R
Indigo Bunting	<i>Passerina cyanea</i>	INBU	SR
Kentucky Warbler	<i>Geothlypis formosus</i>	KEWA	SR
Killdeer	<i>Charadrius vociferous</i>	KILL	R
Least Flycatcher	<i>Empidonax minimus</i>	LEFL	M
Least Tern	<i>Sternula antillarum</i>	LETE	SR
Little Blue Heron	<i>Egretta caerulea</i>	LBHE	SR
Loggerhead Shrike	<i>Lanius ludovicianus</i>	LOSH	R
Mallard	<i>Anas platyrhynchos</i>	MALL	R
Mississippi Kite	<i>Ictinia mississippiensis</i>	MIKI	SR
Mourning Dove	<i>Zenaida macroura</i>	MODO	R
Nashville Warbler	<i>Leiothlypis ruficapilla</i>	NAWA	R
Northern Bobwhite	<i>Colinus virginianus</i>	NOBO	R
Northern Cardinal	<i>Cardinalis cardinalis</i>	NOCA	R
Northern Mockingbird	<i>Mimus polyglottos</i>	NOMO	R
Northern Parula	<i>Setophaga americana</i>	NOPA	SR
Orchard Oriole	<i>Icterus spurius</i>	OROR	SR
Pied-billed Grebe	<i>Podilymbus podiceps</i>	PBGR	R
Pileated Woodpecker	<i>Dryocopus pileatus</i>	PIWO	R
Pine warbler	<i>Setophaga pinus</i>	PIWA	R
Prothonotary Warbler	<i>Protonotaria citrea</i>	PROW	SR
Purple Gallinule	<i>Porphyrio martinica</i>	PUGA	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

**Table 2.** (continued)

<b>Common name</b>	<b>Species name</b>	<b>AOU code</b>	<b>Residency<sup>1</sup></b>
Ruby-crowned Kinglet	<i>Regulus calendula</i>	RCKI	WR
Ruby-throated Hummingbird	<i>Archilochus colubris</i>	RTHU	SR
Song Sparrow	<i>Melospiza melodia</i>	SOSP	WR
Sora	<i>Porzana carolina</i>	SORA	M
Summer Tanager	<i>Piranga rubra</i>	SUTA	SR
Tufted Titmouse	<i>Baeolophus bicolor</i>	TUTI	R
Turkey Vulture	<i>Cathartes aura</i>	TUVU	R
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
Wood Duck	<i>Aix sponsa</i>	WODU	R
Wood Thrush	<i>Hylocichla mustelina</i>	WOTH	SR
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	YBCU	SR
Yellow-breasted Chat	<i>Icteria virens</i>	YBCH	SR
Yellow-throated Vireo	<i>Vireo flavifrons</i>	YTVI	SR
Yellow Warbler	<i>Setophaga petechia</i>	YEWA	M

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

<sup>1</sup> 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 ITIS (Integrated Taxonomic Information System). <http://www.itis.usda.gov/>.

Bolded species names are those species considered of conservation concern for the Mississippi Alluvial Valley Bird Conservation Region (U.S. Fish and Wildlife Service 2008).



## Literature Cited

- Cairns Jr., J., P.V. McCormick and B.R. Niederlehner. 2004. A proposed framework for developing indicators of ecosystem health. *Hydrobiologia* 263:1-44.
- Fancy, S. G. 1997. A new approach for analyzing bird densities from variable circular-plot counts. *Pacific Science* 51:107-114.
- ITIS (Integrated Taxonomic Information System). Accessed 15 October 2015, <http://www.itis.usda.gov/>.
- James, D. A. and J. C. Neal. 1986. *Arkansas Birds: their distribution and abundance*. The University of Arkansas Press, Fayetteville. 402pp.
- Karr, J. R. 1991. Biological integrity: a long-neglected aspect of water resource management. *Ecological Applications* 1:66-84.
- Karr, J. R. and D. R. Dudley. 1981. Ecological perspective on water quality goals. *Environmental Management* 5:55-68.
- Mallory, M.L., H.G. Gilchrist, B.M. Braune and A.J. Gaston. 2006. Marine birds as indicators of arctic marine ecosystem health: linking the northern ecosystem initiative to long-term studies. *Environmental Monitoring and Assessment* 113:31-48.
- Maurer, B.A. 1993. Biological diversity, ecological integrity, and neotropical migrants: New perspectives for wildlife managers. Pages 24-31 *in* D.M. Finch and P.W. Stangel, editors. Status and management of neotropical migratory birds. U.S. Forest Service General Technical Report RM-229.
- NABCI (North American Bird Conservation Initiative). Accessed 15 October 2015, <http://www.nabci-us.org/bcr23.html>.
- Peitz, D.G., G.A. Rowell, J.L. Haack, K.M. James, L.W. Morrison, and M.D. DeBacker. 2008. Breeding bird monitoring protocol for the Heartland Network Inventory and Monitoring Program. Natural Resource Report NPS/HTLN/NRR-2008/044. National Park Service, Fort Collins, Colorado. 152pp.
- Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. *The North American Breeding Bird Survey, Results and Analysis 1966 - 2012. Version 01.30.2015* USGS Patuxent Wildlife Research Center, Laurel, MD.
- U.S. Fish and Wildlife Service. 2008. Birds of Conservation Concern 2008. United States Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia. 85 pp. [Online version available at <<http://www.fws.gov/migratorybirds/>>]

Wood, J.K., N. Nur, C.A. Howell and G.R. Geupel. 2006. Overview of Cosumnes riparian bird study and recommendations for monitoring and management. A Report to the California Bay-Delta Authority Ecosystem Restoration Program. Petaluma, California.

## Appendix A

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007 n=36	2010 n=36	2011 n=27	2012 n=36	2013 n=36	2014 n=36	2015 n=36
Acadian Flycatcher	0.33	0	0.41	0.11	0.06	0.19	0.11
	35	0	43	8	8	22	11
American Coot	0	0	0	0	0	0.14	0
	0	0	0	0	0	8	0
American Crow	0.06	0.11	0	0.17	0.14	0	0
	3	*--	0	--	11	0	0
American Kestrel	0	0	0	0.03	0	0	0
	0	0	0	--	0	0	0
American Redstart	0.03	0	0.15	0	0.03	0	0
	3	0	14	0	3	0	0
Anhinga	0	0	0	0	0	0.06	0.03
	0	0	0	0	0	--	--
Bachman's Sparrow	0.03	0	0	0	0	0	0
	3	0	0	0	0	0	0
<b>Bald Eagle</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.03</b>	<b>0</b>	<b>0</b>
	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>--</b>	<b>0</b>	<b>0</b>
Baltimore Oriole	0	0.06	0	0.03	0.22	0.22	0.08
	0	--	0	3	24	27	11
Barn Swallow	0	0	0	0	0	0.03	0
	0	0	0	0	0	3	0
Barred Owl	0	0	0.04	0.03	0	0.03	0.03
	0	0	--	--	0	3	0

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007	2010	2011	2012	2013	2014	2015
	n=36	n=36	n=27	n=36	n=36	n=36	n=36
Black and White Warbler	0	0	0	0	0	0	0.03
	0	0	0	0	0	0	3
Black-crowned Night-heron	0.03	0	0	0	0	0	0
	--	0	0	0	0	0	0
Black Vulture	0	0	0	0	0.06	0	0
	0	0	0	0	--	0	0
Blue-gray Gnatcatcher	0.28	0.08	0.26	0.22	0.08	0.19	0.42
	35	16	36	14	8	38	54
Blue Grosbeak	0	0	0	0	0.08	0	0.03
	0	0	0	0	19	0	3
Blue Jay	0.11	0.06	0.07	0.14	0.14	0.25	0.14
	5	5	4	11	22	38	11
Brown-headed Cowbird	0.08	0.22	0.30	0.19	0.39	0.17	0.11
	8	19	83	35	46	16	14
Brown Thrasher	0	0.06	0	0.03	0.03	0.14	0
	0	5	0	3	--	14	0
Canada Goose	0	0.06	0	0.11	0	0	0.08
	0	38	0	--	0	0	187
Carolina Chickadee	0.17	0	0.04	0.17	0	0.08	0
	16	0	4	11	0	11	0
Carolina Wren	0.11	0.03	0.30	0.14	0.11	0.44	0.28
	8	3	36	16	22	49	27
Chimney Swift	0	0	0	0	0	0	0.03

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007	2010	2011	2012	2013	2014	2015
	n=36	n=36	n=27	n=36	n=36	n=36	n=36
	0	0	0	0	0	0	--
Chipping Sparrow	0	0.14	0	0	0	0	0
	0	24	0	0	0	0	0
Common Grackle	0	0.14	0.04	0.03	0	0	0.08
	0	51	--	3	0	0	3
Common Moorhen	0.06	0	0	0.11	0.06	0.06	0
	--	0	0	--	3	5	0
Common Yellowthroat	0.03	0.06	0	0	0.03	0.03	0.11
	3	5	0	0	3	3	14
<b>Dickcissel</b>	<b>0.14</b>	<b>0.06</b>	<b>0</b>	<b>0</b>	<b>0.03</b>	<b>0.03</b>	<b>0</b>
	<b>22</b>	<b>5</b>	<b>0</b>	<b>0</b>	<b>--</b>	<b>3</b>	<b>0</b>
Downy Woodpecker	0	0	0.07	0.06	0.03	0.03	0.03
	0	0	7	5	3	3	3
Eastern Bluebird	0.06	0	0.04	0	0	0.03	0
	5	0	4	0	0	3	0
Eastern Kingbird	0.06	0	0	0.03	0	0.03	0
	--	0	0	3	0	3	0
Eastern Meadowlark	0.03	0	0	0	0	0	0
	5	0	0	0	0	0	0
Eastern Phoebe	0	0	0	0.03	0.11	0.14	0
	0	0	0	3	8	16	0
Eastern Towhee	0.06	0	0.04	0	0.03	0	0.03
	5	0	4	0	5	0	3

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007	2010	2011	2012	2013	2014	2015
	n=36	n=36	n=27	n=36	n=36	n=36	n=36
Eastern Wood-pewee	0.33	0	0.48	0.42	0	0.08	0.42
	30	0	47	41	0	8	60
European Starling	0	0.03	0	0	0	0	0
	0	3	0	0	0	0	0
Fish Crow	0	0	0.11	0.03	0.03	0.03	0
	0	0	--	--	--	--	0
Gray Catbird	0	0	0	0	0.03	0.03	0
	0	0	0	0	3	3	0
Great Blue Heron	0	0.06	0.04	0	0.08	0	0.06
	0	--	--	0	--	0	--
Great Crested Flycatcher	0.08	0	0.11	0	0.03	0	0.39
	8	0	11	0	5	0	41
Great Egret	0.06	0.17	0.11	0.36	0.31	0.14	0.11
	--	3	--	--	--	--	--
Hairy Woodpecker	0.03	0	0.07	0	0.06	0	0.06
	5	0	7	0	5	0	5
House Sparrow	0	0	0	0.03	0.03	0	0
	0	0	0	--	3	0	0
House Wren	0.03	0	0	0	0	0	0.03
	3	0	0	0	0	0	3
Indigo Bunting	0.28	0.28	0.26	0.19	0.25	0.33	0.44
	43	35	40	16	52	43	65
<b>Kentucky Warbler</b>	<b>0.06</b>	<b>0</b>	<b>0.15</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0.03</b>

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007 n=36	2010 n=36	2011 n=27	2012 n=36	2013 n=36	2014 n=36	2015 n=36
	5	0	14	0	0	0	3
Killdeer	0	0	0.04	0	0	0	0
	0	0	--	0	0	0	0
Least Tern	0	0	0	0	0	0.03	0
	0	0	0	0	0	5	0
Little Blue Heron	0	0	0	0	0.03	0	0.03
	0	0	0	0	--	0	--
Loggerhead Shrike	0	0.03	0	0	0	0.03	0
	0	3	0	0	0	3	0
Mallard	0	0	0	0	0	0	0.03
	0	0	0	0	0	0	3
Mississippi Kite	0	0.03	0	0	0.06	0.03	0
	0	--	0	0	--	--	0
Mourning Dove	0.17	0.11	0.07	0.56	0.14	0.31	0.11
	8	5	4	30	19	51	11
Nashville Warbler	0	0	0	0.03	0	0	0
	0	0	0	3	0	0	0
Northern Bobwhite	0	0	0.04	0	0	0	0.08
	0	0	--	0	0	0	8
Northern Cardinal	0.61	0.17	0.52	0.64	0.47	0.50	0.42
	76	27	83	79	46	70	49
Northern Mockingbird	0.31	0.08	0.11	0.14	0.08	0.11	0.03
	19	8	7	14	5	8	3

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007 n=36	2010 n=36	2011 n=27	2012 n=36	2013 n=36	2014 n=36	2015 n=36
Northern Parula	0.19	0	0	0	0	0	0.03
	16	0	0	0	0	0	3
<b>Orchard Oriole</b>	<b>0.03</b>	<b>0</b>	<b>0.07</b>	<b>0.08</b>	<b>0.11</b>	<b>0.11</b>	<b>0</b>
	--	<b>0</b>	<b>7</b>	<b>8</b>	<b>14</b>	<b>11</b>	<b>0</b>
Pied-billed Grebe	0	0	0	0	0	0.08	0
	0	0	0	0	0	3	0
Pileated Woodpecker	0.06	0.03	0.26	0.31	0.19	0.33	0.03
	3	3	25	16	22	33	3
Pine warbler	0	0	0	0	0.03	0.03	0
	0	0	0	0	3	3	0
<b>Prothonotary Warbler</b>	<b>0.08</b>	<b>0</b>	<b>0</b>	<b>0.14</b>	<b>0.11</b>	<b>0.11</b>	<b>0.06</b>
	<b>8</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>14</b>	<b>11</b>	<b>5</b>
Purple Gallinule	0	0	0	0.03	0	0	0
	0	0	0	--	0	0	0
Red-bellied Woodpecker	0.33	0.11	0.26	0.03	0.14	0.19	0.28
	30	14	25	--	11	22	27
Red-eyed Vireo	0.03	0	0.04	0	0	0.03	0.06
	3	0	4	0	0	3	5
<b>Red-headed Woodpecker</b>	<b>0</b>	<b>0</b>	<b>0.04</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
	<b>0</b>	<b>0</b>	<b>4</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Red-shouldered Hawk	0	0	0	0.03	0	0	0
	0	0	0	--	0	0	0
Red-tailed Hawk	0	0.03	0	0	0	0.03	0



**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007 n=36	2010 n=36	2011 n=27	2012 n=36	2013 n=36	2014 n=36	2015 n=36
	0	3	0	0	0	--	0
Red-winged Blackbird	0.17	0.31	0	0.11	0.28	0.22	0.14
	22	62	0	14	24	27	11
Ruby-throated Hummingbird	0	0.14	0.07	0.28	0	0.22	0.11
	0	11	7	33	0	11	11
Summer Tanager	0.28	0.03	0.11	0.14	0.19	0.25	0.39
	33	3	11	11	22	38	38
Tufted Titmouse	0.22	0.06	0.33	0.08	0.08	0.36	0.39
	19	8	33	8	16	54	46
Turkey Vulture	0	0	0	0	0	0	0.03
	0	0	0	0	0	0	--
White-breasted Nuthatch	0	0	0.04	0	0	0	0
	0	0	4	0	0	0	0
White-eyed Vireo	0.06	0	0.04	0	0	0	0.14
	5	0	4	0	0	0	14
Wild Turkey	0	0	0.04	0.03	0	0	0
	0	0	--	--	0	0	0
Wood Duck	0	0.06	0	0.06	0	0.03	0.03
	0	--	0	--	0	--	--
<b>Wood Thrush</b>	<b>0</b>	<b>0</b>	<b>0.07</b>	<b>0</b>	<b>0</b>	<b>0.03</b>	<b>0.08</b>
	<b>0</b>	<b>0</b>	<b>7</b>	<b>0</b>	<b>0</b>	<b>3</b>	<b>14</b>
Yellow-billed Cuckoo	0.33	0	0.33	0.06	0	0.33	0.39
	22	0	29	--	0	41	41

**Appendix A.** Annual proportion of plots occupied (includes flyovers) by, and estimated abundance (determined using bird within 100-m of plot center) of breeding bird species at Arkansas Post National Memorial, Arkansas during the 2007-2015 (excluding 2008-09) spring bird surveys.

Common name	<u>Proportion of plots occupied</u>						
	Abundance						
	2007	2010	2011	2012	2013	2014	2015
	<b>n=36</b>	<b>n=36</b>	<b>n=27</b>	<b>n=36</b>	<b>n=36</b>	<b>n=36</b>	<b>n=36</b>
Yellow-breasted Chat	0.19	0	0	0	0.03	0.08	0.22
	16	0	0	0	3	8	30
Yellow-throated Vireo	0.17	0	0.04	0	0	0	0.06
	16	0	4	0	0	0	5

\* — denotes when a species was present on a plot but outside 100-m of plot center therefore their annual abundance value could not be calculated.

Bolded species names are those species considered of conservation concern for the Mississippi Alluvial Valley Bird Conservation Region (U.S. Fish and Wildlife Service 2008).

## Appendix B.

**Appendix B.** Regional trends in breeding birds recorded on Arkansas Post National Memorial (ARPO), Arkansas for years 2007 through 2013.

Common name	Trend	95% Confidence Interval	
		Lower	Upper
Acadian Flycatcher	1.17	-6.45	7.76
American Coot	na	na	na
American Crow	3.28	0.26	6.96
American Kestrel	1.22	-30.78	44.05
American Redstart	-14.20	-36.42	9.45
Anhinga	13.29	2.59	32.83
Bachman's Sparrow	na	na	na
<b>Bald Eagle</b>	<b>66.02</b>	<b>21.73</b>	<b>154.51</b>
Baltimore Oriole	-4.38	-9.09	0.76
Barn Swallow	4.30	0.99	7.37
Barred Owl	3.11	-4.01	9.39
Black-crowned Night-heron	4.27	-16.85	40.39
Black Vulture	8.25	-7.87	30.43
Blue-gray Gnatcatcher	1.74	-3.01	6.97
Blue Grosbeak	4.86	0.01	8.92
Blue Jay	0.20	-1.77	2.47
Brown-headed Cowbird	0.29	-3.74	5.56
Brown Thrasher	-1.51	-4.67	2.10
Canada Goose	24.04	-5.80	48.44
Carolina Chickadee	-2.02	-5.72	1.15
Carolina Wren	-0.52	-3.34	2.09

**Appendix B.** Regional trends in breeding birds recorded on Arkansas Post National Memorial (ARPO), Arkansas for years 2007 through 2013.

Common name	Trend	95% Confidence Interval	
		Lower	Upper
Chimney Swift	-1.79	-5.96	2.85
Chipping Sparrow	-11.77	-30.75	8.39
Common Grackle	-3.29	-6.13	-0.62
Common Moorhen	14.69	-0.59	40.72
Common Yellowthroat	-4.48	-7.76	-1.30
<b>Dickcissel</b>	<b>2.88</b>	<b>-1.54</b>	<b>7.41</b>
Downy Woodpecker	2.96	-1.24	7.72
Eastern Bluebird	3.61	-1.31	8.90
Eastern Kingbird	-2.00	-5.91	1.67
Eastern Meadowlark	-3.85	-6.72	-1.42
Eastern Phoebe	1.53	-5.77	12.55
Eastern Towhee	1.09	-1.59	4.56
Eastern Wood-pewee	1.75	-2.71	7.71
European Starling	-1.59	-4.74	2.16
Fish Crow	0.82	-6.20	9.34
Gray Catbird	-0.93	-13.19	6.77
Great Blue Heron	-4.95	-15.38	4.08
Great Crested Flycatcher	3.02	-0.59	7.64
Great Egret	7.83	-1.23	16.47
Grasshopper Sparrow*	-0.73	-10.87	15.93
Green Heron*	-0.14	-5.32	3.83
Hairy Woodpecker	-1.89	-9.00	5.96

**Appendix B.** Regional trends in breeding birds recorded on Arkansas Post National Memorial (ARPO), Arkansas for years 2007 through 2013.

Common name	Trend	95% Confidence Interval	
		Lower	Upper
House Sparrow	-4.01	-6.52	-1.28
House Wren	na	na	na
Indigo Bunting	-2.13	-4.99	0.61
<b>Kentucky Warbler</b>	<b>2.01</b>	<b>-4.15</b>	<b>9.59</b>
Killdeer	1.25	-2.23	4.18
Least Tern	16.30	-10.80	87.48
Little Blue Heron	-1.54	-7.08	3.99
Loggerhead Shrike	-1.15	-4.72	2.11
Mallard	8.13	-10.07	24.50
Mississippi Kite	2.73	-3.55	8.19
Mourning Dove	-0.11	-2.01	2.69
Nashville Warbler	na	na	na
Northern Bobwhite	-6.25	-10.56	-2.58
Northern Cardinal	-0.11	-1.86	1.64
Northern Mockingbird	-0.36	-1.81	1.34
Northern Parula	-1.84	-5.69	3.30
<b>Orchard Oriole</b>	<b>-4.07</b>	<b>-7.22</b>	<b>-1.26</b>
Pied-billed Grebe	0.98	-14.42	30.85
Pileated Woodpecker	1.26	-2.40	5.74
Pine warbler	-12.61	-23.82	1.83
<b>Prothonotary Warbler</b>	<b>-2.33</b>	<b>-6.74</b>	<b>1.32</b>
Purple Gallinule	na	na	na

**Appendix B.** Regional trends in breeding birds recorded on Arkansas Post National Memorial (ARPO), Arkansas for years 2007 through 2013.

Common name	Trend	95% Confidence Interval	
		Lower	Upper
Red-bellied Woodpecker	0.93	-1.63	3.58
Red-eyed Vireo	-3.53	-10.60	2.08
<b>Red-headed Woodpecker</b>	<b>-0.92</b>	<b>-10.74</b>	<b>3.74</b>
Red-shouldered Hawk	1.33	-3.79	6.38
Red-tailed Hawk	4.90	-1.96	10.30
Red-winged Blackbird	0.65	-4.06	5.27
Ruby-throated Hummingbird	-2.67	-12.52	7.48
Summer Tanager	-1.94	-8.24	3.74
Tufted Titmouse	5.20	2.23	8.91
Turkey Vulture	6.51	-5.36	12.96
White-breasted Nuthatch	-1.46	-27.82	13.51
White-eyed Vireo	-2.50	-6.28	0.97
Wild Turkey	7.72	-25.25	33.05
Wood Duck	1.32	-4.44	7.23
<b>Wood Thrush</b>	<b>-0.76</b>	<b>-5.81</b>	<b>4.71</b>
Yellow-billed Cuckoo	-1.84	-4.86	0.78
Yellow-breasted Chat	-0.48	-3.87	3.29
Yellow-throated Vireo	2.08	-5.68	8.25

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

Bolded species names are those species considered of conservation concern for the Mississippi Alluvial Valley Bird Conservation Region (U.S. Fish and Wildlife Service 2008).

Regional trend data from BBS surveys (Sauer et al. 2014).

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 411/130832, December 2015

**National Park Service**  
**U.S. Department of the Interior**



---

**Natural Resource Stewardship and Science**  
1201 Oakridge Drive, Suite 150  
Fort Collins, CO 80525

[www.nature.nps.gov](http://www.nature.nps.gov)

**EXPERIENCE YOUR AMERICA™**