A SONGBIRD INVENTORY OF ARKANSAS POST NATIONAL MEMORIAL

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December 2004

Technical Report NPS/HTLN/ARPO/ H7110B10001

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Inventory and Monitoring Program
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Summary

Arkansas Post National Memorial was surveyed to determine songbird species composition, richness, diversity and evenness of nesting guilds and migratory status via fixed radius census plots. At the Memorial unit, 60 species were recorded with the most common species encountered being the brown-headed cowbird, red-winged blackbird, and the northern cardinal. Here, about 2½ times more resident birds were recorded than migratory birds and likewise, diversity was similar for resident and migratory species. However, evenness was greater for migratory than for resident species. On a per day average, more birds nested in the canopy than cavities, shrubs, and on the ground. Diversity of canopy nesting species was greatest, however, evenness of canopy nesting species was similar to that of cavity nesters but greater than shrub or ground nesters. At the Osotouy unit, 42 species were recorded with the most common species encountered being the indigo bunting, Carolina wren, and yellow-billed cuckoo. Here, about 50% fewer resident birds were recorded than migratory birds and likewise, diversity was greater for migratory species. However, evenness for migratory and resident species were similar. On a per day average, more birds nested in the canopy than cavities, shrubs, and on the ground. Diversity of canopy nesting species was greatest, however evenness was similar for all nesting habitats except ground nests. No federal or state T&E species were documented but eight species currently tracked by the Arkansas Natural Heritage Commission were documented.

Acknowledgments

Thanks to Allison Fowler and Erin McCammon, graduate students at the University of Arkansas – Monticello, for many early morning bird surveys, and to Chris Watt with the Arkansas Forest Resources Center for his technical assistance. Also, thanks to the personnel of Arkansas Post National Memorial for providing assistance and support for the project, and to the Heartland Network Inventory and Monitoring Program for funding the project.

Introduction

Congress passed the National Parks Omnibus Management Act in 1998 in response to concerns about the condition of natural resources within the national parks. The act requires each park to gather baseline inventory data on pertinent natural resources, data that will provide a pivotal step toward establishing an effective monitoring program furthering the ability to effectively manage and protect park resources and abide by the National Park Service (NPS) mission statement. The NPS responded with the Natural Resource Challenge program, including the establishment of biome-based inventory and monitoring networks. The Heartland Network, as part of the NPS Inventory and Monitoring (I&M) program, has undertaken inventories of vascular plants and vertebrates within fifteen parks in eight Midwestern states. Stemming from this challenge and a concern regarding the status of songbird populations at Arkansas Post National Memorial, an inventory was deemed necessary to establish baseline data of songbirds within the park.

Arkansas Post National Memorial, including the Osotouy Unit, provides refuge to numerous species of songbirds. Songbirds are an ecologically important faunal group that can be influenced by structural and floristic habitat alterations that may result from a variety of management activities. Songbirds help facilitate seed and fungi dispersal, help control insect numbers, play essential roles in food web dynamics, and can create habitat for other wildlife species through excavation of cavities. In addition to their ecological values, nongame birds are important as a recreational resource to millions of people that watch and feed birds. Neotropical migratory birds are of particular research interest due to recent evidence of long-term population declines in many species.

An inventory of bird species is a necessary first step toward understanding how songbird populations relate to natural and cultural resources and associated management activities at the park. and will also help the park better manage resources and predict the possible impacts of management decisions on avian species (an important component of the National Environmental Policy Act (NEPA)). It will also provide managers with information about future research , such as fecundity surveys on species of concern, or other important questions. Additionally, an inventory of bird species establishes a baseline for future monitoring efforts aimed at detecting potential population/species composition trends.

The objective for this inventory was the assessment of species composition, richness and evenness, and diversity of migrant and resident species.

Study Area

Arkansas Post National Memorial is made up of two units, the Memorial and Osotouy Unit. Both units are located in the southeastern portion of Arkansas County, Arkansas but are not contiguous units: the Memorial Unit is located 11.2 km (7 mi) south of Gillett, AR and the Osotouy Unit is located approximately 12.8 km (8 mi) from the community of Tichnor. Both areas are characterized by a terrace landscape, flat terrain, and various stands of upland and lowland hardwoods, interspersed with bayous and swamps.

The following is excerpted from Boetsch et al 2000.
The main unit of Arkansas Post National Memorial consists of a peninsula surrounded by water, and is comprised of 157.6 ha (389.17 ac)**.** A terrace landscape, flat terrain, and various stands of upland and lowland hardwoods, interspersed with bayous and swamps characterize the area. Also within the main unit are manicured lawns, prairie, and tall-grass areas. Moore and Post Bayous lie along the north/northwest border, and Post Lake, a backwater of the Arkansas River, lies on the north and northeastern border. Both bayous, as well as the backwater, empty into the Arkansas River along the southern edge of the main unit.

The land base of 115.8 ha (286 ac) here consists of 13 different vegetation types which range from primarily oak dominated forest stands to pine stands as well as a restored prairie and several, chronologically diverse, successional stands. Prescribed burns have been halted due to the detrimental effects of past burns, until research can be completed for several projects including fire history and cultural landscape reports. Additionally, due to past fire regimes, the canopy of the forested regions have been broken up exposing the forest floor to sunlight. These areas are subject to pronounced exotic vegetation invasions. Little is known of the effects that fire has on lowland bottomland and terrace landscapes. Therefore, fire cannot be utilized for exotic plant control at Arkansas Post National Memorial. The exotic trifoliate orange (*Poncirus trifoliata*) has overtaken approximately 4 ha (10 ac) in the main unit and numerous areas of smaller size exist as well. Even though the quantity of exotic vegetation seems small on the main unit presently, when the land base is considered, roughly eight to nine percent of the unit is made up of exotics.

The Osotouy unit consists of 145.8 ha (360 ac), the majority being land based, bringing the total park acreage, including both units, to approximately 303.6 ha (750 ac). The southwestern portion of Osotouy is bordered by an old oxbow of the Arkansas River, Lake Dumond. The southern border is contiguous with U.S. Fish and Wildlife Service land, while the remaining boundaries abut private land. Menard bayou enters the unit from the east and exits out across the northern boundary. This park unit consists of common bottomland species including pecan (*Carya illinoensis*), sycamore (*Platanus occidentalis*), and occasional small stands of oak as well as some tall grass areas. At one time, an area known as the “little prairie” extended into this unit.

An abundance of flora and fauna resides in both park units, on land and in water. The land base portion of both units has undergone sweeping changes over the past 300 years due to both natural and cultural effects but is currently, since its inclusion in the National Park System, one of the few natural strongholds left in the area. The main unit presents a mosaic of successional development while portions of Osotouy have been logged or are under cultivation. Land

immediately adjacent to both units is either under agricultural cultivation or is being (or has been) logged. Although exotics exist at the Osotouy unit, little is known of their current status. Prescribed burns, its effect on park ecosystems, and forest health are primary points of interest for resource management. Other main areas of concern include tick-borne disease frequencies, fisheries management of the ponds and bayous, bank erosion, and exotic plants and animals.

Materials and Methods

Arkansas Post National Memorial was surveyed to determine current songbird species composition during 9 June – 7 August, 2003 via fixed radius census plots.

Fourteen 50-m fixed-radius bird census plots were established at the Memorial unit and eight at the Osotouy unit. Plots were located to provide an adequate sample of bird species that occur in the various vegetation types (Figure 1). However, the size of vegetation units at both units precluded replication. Plots were situated to provide easy access for future monitoring purposes (i.e., along roads and trails). The interspersion and juxtaposition of a variety of vegetation types along with maintained lawns, trails, and roads provided a landscape with numerous edges and little continuity. Thus, placement of census points along roads and trails was reasonable for this particular landscape. Each point was recorded (Lat/Lon) using a eTrex Vista Global Positioning System (GPS) portable hand-held unit with WAAS enabled accuracy less than three meters.

Each plot was sampled using a 5-minute count of all songbirds heard or seen. All counts were conducted within 3.5 hours of sunrise on days with little or no rain and with winds < 6-11 kph. Plots were sampled 3 times each by 2 observers on different days; thus, each plot was sampled a total of 6 times. Species that do not breed in the area, species for which point sampling is an inappropriate sampling methodology, and flyovers were recorded but not used in the analyses. Species nomenclature follows the American Ornithologist Union Checklist for North American Birds (2004).

Mean numbers of individuals, species richness (number of species), diversity (Shannon diversity index), and evenness (Pielou's J) were computed for all breeding birds combined and for each of the following subsets: residents, migrants (short- and long-distance combined), canopy nesters, cavity nesters, ground nesters, and shrub nesters. Resident and migratory means were compared using an independent *t*-test. Nesting guild means were compared using a one-way ANOVA and tukey's mean separation test. All analyses were conducted using SPSS 13.0 (SPSS, Inc. 2004).

Results

Memorial Unit

A total 1,153 individual birds ($\bar{x}$ = 164/day) representing 60 species ($\bar{x}$ = 32/day) were recorded (Tables 1 and 2). The most common species encountered was the brown-headed cowbird (*Molothrus ater*), followed by the red-winged blackbird (*Agelaius phoeniceus*) and the northern cardinal (*Cardinalis cardinalis*). Individuals of these three species comprised 30% of the total number of birds recorded despite representing only 5% of the species encountered.

About 2½ times more resident birds ($\bar{x}$ = 116 individuals/day) were recorded than migratory birds ($\bar{x}$ = 48 individuals/day)(Table 2). A similar number of resident ($\bar{x}$ = 17) and migratory ($\bar{x}$ = 16) species were encountered (Table 2). Likewise, diversity was similar for resident ($\bar{x}$ = 2.4/day) and migratory ($\bar{x}$ = 2.4/day) species (Table 2). However, evenness was greater for migratory species ($\bar{x}$ = 0.88/day) than for resident species ($\bar{x}$ = 0.85/day)(Table 2).

An average of 78 canopy nesting birds were recorded per day, compared to 32 cavity nesters, 56 shrub nesters, and 12 ground nesters (Table 3). Additionally, an average of 16 canopy nesting species was encountered per day (Table 3). This was approximately twice as many species than that recorded for cavity nesters ($\bar{x}$ = 9) and shrub nesters ($\bar{x}$ = 8), and 8 times greater than the number of recorded ground nesting species ($\bar{x}$ = 2)(Table 3). Diversity ($\bar{x}$ = 2.4/day) of canopy nesting species was also greater than diversity of other nesting guilds (Table 3). Cavity nesters were the second most diverse group ($\bar{x}$ = 1.8/day), followed by shrub ($\bar{x}$ = 1.4/day) and ground ($\bar{x}$ = 0.5/day) nesters (Table 3). Evenness ($\bar{x}$ = 0.88/day) of canopy nesting species was similar to that of cavity nesters ($\bar{x}$ = 0.84/day) and greater than shrub ($\bar{x}$ = 0.70/day) or ground ($\bar{x}$ = 0.59/day) nesters (Table 3).

Osotouy Unit

A total 472 individual birds ($\bar{x}$ = 74/day) representing 42 species ($\bar{x}$ = 19/day) were recorded (Tables 4 and 5).

The most common species encountered was the indigo bunting (*Passerina cyanea*), followed by the Carolina wren (*Thryothorus ludovicianus*) and the yellow-billed cuckoo (*Coccyzus americanus*). Individuals of these three species comprised 30% of the total number of birds recorded despite representing only 7% of the species encountered.

About 50% fewer resident birds ($\bar{x}$ = 28 individuals/day) were recorded than migratory birds ($\bar{x}$ = 46 individuals/day)(Table 5). Migratory birds represented approximately 40% more species ($\bar{x}$ = 11/day) than resident birds ($\bar{x}$ = 8/day)(Table 5). Likewise, diversity was greater for migratory species ($\bar{x}$ = 2.2/day) than for resident species ($\bar{x}$ = 1.8/day)(Table 5). However, evenness for migratory ($\bar{x}_{evenness}$ = 0.90/day) and resident ($\bar{x}_{evenness}$ = 0.89/day) species were similar (Table 5).

An average of 40 canopy nesting birds were recorded per day, compared to 13 cavity nesters, 21 shrub nesters, and 8 ground nesters (Table 6). Additionally, an average of 10 canopy nesting

species was encountered per day (Table 6). This was approximately twice as many species than that recorded for cavity nesters ($\bar{x}$ = 4) and shrub nesters ($\bar{x}$ =5), and 5 times greater than the number of recorded ground nesting species ($\bar{x}$ = 2)(Table 6). Diversity of canopy nesting species ($\bar{x}$ = 2.1/day) was also greater than diversity of other nesting guilds (Table 6). Shrub nesters were the second most diverse group ($\bar{x}$ = 1.3/day), followed by cavity ($\bar{x}$ = 1.1/day) and ground ($\bar{x}$ = 0.2/day) nesters (Table 6). Evenness was least for ground nesting species ($\bar{x}$ = 0.58/day), but similar among canopy ($\bar{x}$ = 0.91/day), cavity ($\bar{x}$ = 0.79/day), and shrub ($\bar{x}$ = 0.81/day) nesters (Table 6).

Eight species currently tracked by the Arkansas Natural Heritage Commission (2004) were documented. These include two that are currently being inventoried: common moorhen (*Gallinula chloropus*) and purple gallinule (*Porphyrula martinica*; syn. *Porphyrio martinicus*); two that are being monitored: great blue heron (*Aredea herodias*) and double crested cormorant (*Phalacrocorax auritus*); and four that are on the watch list: yellow warbler (*Dendorica petechia*), red headed woodpecker (*Melanerpes erythrocephalus*), hairy woodpecker (*Picoides villosus*), and blue winged warbler (*Vermivora pinus*).

Discussion

The composition and structure of the bird communities found at both units are dissimilar. Numerically, bird species richness and diversity was greater at the Memorial unit compared to the Osotouy unit for both resident and migratory birds, as well as for all nesting guilds. The two most common species at the Memorial unit were the brown-headed cowbird and the red-winged blackbird. In contrast, the two most common species at the Osotouy unit were the indigo bunting and the Carolina wren. These differences in bird communities are the result of differences in the composition, structure, and patterns of vegetation.

At the Memorial unit, the interspersion and juxtaposition of a variety of vegetation types along with maintained lawns, trails, and roads characterize a diverse and fragmented landscape with numerous edges. This variety of habitats provides for a diverse bird community. However, combined with a close proximity to agricultural fields, the diverse, fragmented habitat also creates an ideal environment for the brown-headed cowbird. The prevalence of the brown-headed cowbird raises a concern of the level of nest parasitism occurring at the unit. If nest parasitism is high, this unit could potentially represent a population sink for some bird species.

Though the Osotouy unit is in relatively close proximity to agricultural fields and bodies of water, it represents a less diverse, and less fragmented, environment. Thus, the number and diversity of bird species is less than those found at the Memorial unit. However, the brown-headed cowbird represented only 0.4% of the birds encountered at Osotouy. In the future, any development at Osotouy should consider possible ramifications of changes to habitat, particularly in respect to fragmentation.

Literature Cited

American Ornithologist Union Checklist of North American Birds. 2004. http://www.aou.org/checklist/index.php3.

Arkansas Natural Heritage Commission. 2004. Animals of special concern. http://www.naturalheritage.org/publications/rare/. Accessed December 1, 2004.

Boetsch, J.; DeBacker, M.; Hughes, P.; Peitz, D.; Thomas, L.; Wagner, G.; Witcher, B. 2000. A study plan to inventory vascular plants and vertebrates: Heartland Network, National Park Service.

SPSS, Inc. 2004. SPSS Version 13.0. Chicago, IL: SPSS, Inc.

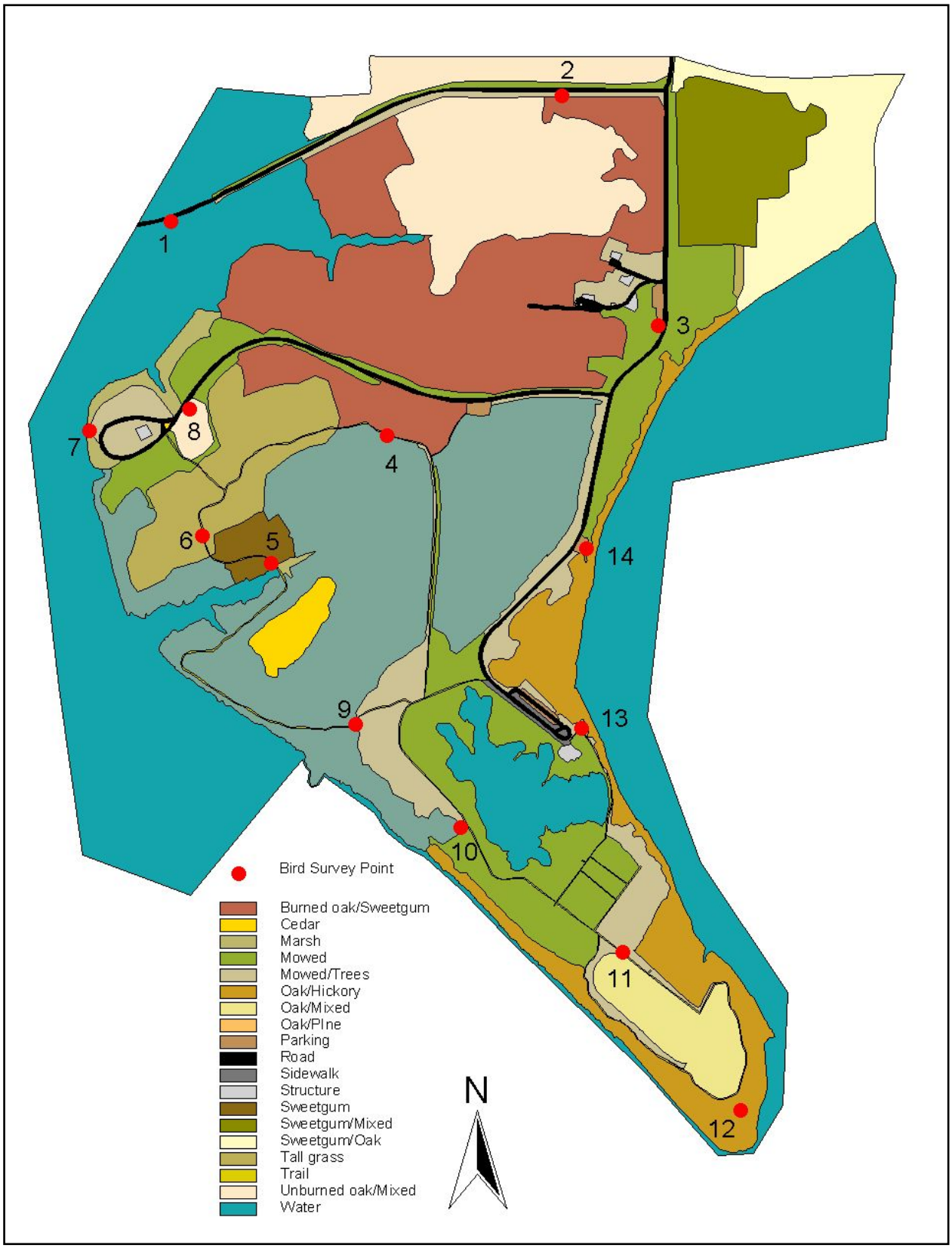

Figure 1. Locations of 50-m fixed-radius bird survey plots at Arkansas Post National Memorial.

Figure 2. Locations of 50-m fixed-radius bird survey plots at the Osotouy Unit.

Table 1. List of birds recorded at Arkansas Post National Memorial, June – July 2003.

Common Name	Scientific Name	# of Individuals	% Total
Brown-headed Cowbird	Molothrus ater	163	14.1
Red-winged Blackbird	Agelaius phoeniceus	108	9.4
Northern Cardinal	Cardinalis cardinalis	86	7.5
Red-bellied Woodpecker	Melanerpes carolinus	59	5.1
Carolina Wren	Thryothorus ludovicianus	59	5.1
Eastern Wood Peewee	Contopus virens	55	4.8
Yellow-billed Cuckoo	Coccyzus americanus	51	4.4
Mourning Dove	Zenaida macroura	46	4.0
Eastern Tufted Titmouse	Baeolophus bicolor	38	3.3
Common Grackle	Quiscalus quiscula	36	3.1
Carolina Chickadee	Poecile carolinensis	36	3.1
Northern Rough Winged Swallow[1]	Stelgidopteryx serripennis	35	3.0
Acadian Flycatcher	Empidonax virescens	31	2.7
Great Egret[1]	Ardea alba	30	2.6
Northern Mockingbird	Mimus polyglottos	28	2.4
Summer Tanager	Piranga rubra	25	2.2
Fish Crow	Corvus ossifragus	21	1.8
Blue-gray Gnatcatcher	Polioptila caerulea	21	1.8
Blue Jay	Cyanocitta cristata	19	1.6
Downy Woodpecker	Picoides pubescens	18	1.6
Baltimore Oriole	Icterus galbula	15	1.3
American Crow	Corvus brachyrhynchos	15	1.3
Cattle Egret[3]	Bubulcus ibis	14	1.2
Barn Swallow[1]	Hirundo rustica	10	0.9
Hairy Woodpecker	Picoides villosus	9	0.8
Wood Thrush	Hylocichla mustelina	9	0.8
Eastern Towhee	Pipilo erythrophthalmus	8	0.7
Eastern Bluebird	Sialia sialis	8	0.7
Northern Parula	Parula americana	8	0.7
Great-crested Flycatcher	Myiarchus crinitus	6	0.5
Indigo Bunting	Passerina cyanea	6	0.5
Brown Thrasher	Toxostoma rufum	6	0.5
White-eyed Vireo	Vireo griseus	6	0.5
Orchard Oriole	Icterus spurius	5	0.4
Prothonotary Warbler	Protonotaria citrea	5	0.4
Northern Flicker	Colaptes auratus	5	0.4
Common Moorhen[1]	Gallinula chloropus	4	0.3
Eastern Kingbird	Tyrannus tyrannus	4	0.3

Table 1. Species of birds recorded at Arkansas Post National Memorial, June – July 2003 (cont.).

Common Name	Scientific Name	# of Individuals	% Total
Mallard[3]	Anas platyrhynchos	4	0.3
American Robin	Turdus migratorius	4	0.3
Yellow Warbler	Dendroica petechia	4	0.3
Double-crested Comorant[2]	Phalacrocorax auritus	3	0.3
Pileated Woodpecker	Dryocopus pileatus	3	0.3
Purple Gallinule[1]	Porphyrio martinicus	3	0.3
Red-headed Woodpecker	Melanerpes erythrocephalus	3	0.3
Blue Grosbeak	Guiraca caerulea	2	0.2
Belted Kingfisher[1]	Ceryle alcyon	2	0.2
European Starling	Sturnus vulgaris	2	0.2
Great Blue Heron[1]	Ardea herodias	2	0.2
Ovenbird[2]	Seiurus aurocapillus	2	0.2
Red-eyed Vireo	Vireo olivaceus	2	0.2
Chimney Swift[3]	Chaetura pelagica	1	0.1
Blue-winged Warbler[2]	Vermivora pinus	1	0.1
Horned Lark	Eremophila alpestris	1	0.1
Kentucky Warbler	Oporornis formosus	1	0.1
Barred Owl[1]	Strix varia	1	0.1
Pine Warbler	Dendroica pinus	1	0.1
American Redstart	Setophaga ruticilla	1	0.1
Red-shouldered Hawk[3]	Buteo lineatus	1	0.1
Gray Catbird	Dumetella carolinensis	1	0.1
	Total	1,153	100%

[1] Inappropriate sampling technique.
[2] Non-breeding migrant.
[3] Recorded only as a flyover.

Table 2. Mean number per day (SE) of individuals, species, diversity, and evenness by migratory status for birds recorded at Arkansas Post National Memorial, June – July 2003.

		Migratory Status		
Variable	**All Species**	**Resident**	**Migrant**	***P***
Individuals	164.2 (5.57)	116.0 (5.45)	48.2 (2.01)	<0.001
Species	32.3 (1.48)	16.8 (0.95)	15.5 (0.72)	0.288
Diversity	2.990 (0.0240)	2.377 (0.0327)	2.410 (0.0410)	0.560
Evenness	0.862 (0.0098)	0.845 (0.0124)	0.881 (0.0080)	0.033

Table 3. Mean number per day (SE) of individuals, species, diversity, and evenness by nesting guild for birds recorded at Arkansas Post National Memorial, June – July 2003.

	Nesting Guild			
Variable	**Canopy**	**Cavity**	**Shrub**	**Ground**
Individuals	78.2 A[1] (4.44)	31.7 B (1.52)	56.2 C (4.00)	11.7 D (0.88)
Species	16.0 A (0.86)	8.8 B (0.40)	8.0 B (0.52)	2.3 C (0.42)
Diversity	2.434 A (0.0249)	1.821 B (0.0379)	1.436 C (0.0399)	0.456 D (0.1302)
Evenness	0.881 A (0.0132)	0.838 A (0.0066)	0.695 B (0.0138)	0.585 B (0.0614)

[1]Means in the same row followed by the same letter are not different ($P < 0.05$).

Table 4. List of of birds recorded at Osotouy, July – August 2003.

Common Name	Scientific Name	# of Individuals	% Total
Indigo Bunting	Passerina cyanea	61	12.9
Carolina Wren	Thryothorus ludovicianus	43	9.1
Yellow-billed Cuckoo	Coccyzus americanus	42	8.9
Northern Cardinal	Cardinalis cardinalis	42	8.9
Eastern Wood Peewee	Contopus virens	33	7.0
Wood Thrush	Hylocichla mustelina	30	6.4
Acadian Flycatcher	Empidonax virescens	29	6.1
Mourning Dove	Zenaida macroura	24	5.1
Red-bellied Woodpecker	Melanerpes carolinus	21	4.4
Summer Tanager	Piranga rubra	19	4.0
White-eyed Vireo	Vireo griseus	14	3.0
Blue Jay	Cyanocitta cristata	13	2.8
Blue Grosbeak	Guiraca caerulea	12	2.5
Eastern Tufted Titmouse	Baeolophus bicolor	12	2.5
Red-eyed Vireo	Vireo olivaceus	8	1.7
Great Egret[1]	Ardea alba	8	1.7
Carolina Chickadee	Poecile carolinensis	7	1.5
Northern Flicker	Colaptes auratus	5	1.1
Prothonotary Warbler	Protonotaria citrea	5	1.1
Downy Woodpecker	Picoides pubescens	4	0.8
Fish Crow	Corvus ossifragus	3	0.6
Red-shouldered Hawk[3]	Buteo lineatus	3	0.6
Pileated Woodpecker	Dryocopus pileatus	3	0.6
Common yellow-throat	Geothlypis trichas	2	0.4
Cattle Egret[3]	Bubulcus ibis	2	0.4
Brown-headed Cowbird	Molothrus ater	2	0.4
Northern Mockingbird	Mimus polyglottos	2	0.4
Wild Turkey[1]	Meleagris gallopavo	2	0.4
Ruby-throated Hummingbird	Archilochus colubris	2	0.4
Red-winged Blackbird	Agelaius phoeniceus	2	0.4
Ovenbird[2]	Seiurus aurocapillus	2	0.4
Great Blue Heron[1]	Ardea herodias	2	0.4
Northern Bobwhite[1]	Colinus virginianus	2	0.4
Blue-gray Gnatcatcher	Polioptila caerulea	2	0.4
Kentucky Warbler	Oporornis formosus	2	0.4
Chipping Sparrow	Spizella passerina	1	0.2
Double-crested Comorant[2]	Phalacrocorax auritus	1	0.2
Hairy Woodpecker	Picoides villosus	1	0.2

Table 4. List of of birds recorded at Osotouy, July – August 2003 (cont).

Common Name	Scientific Name	# of Individuals	% Total
Red-tailed Hawk[1]	Buteo jamaicensis	1	0.2
Brown Thrasher	Toxostoma rufum	1	0.2
Eastern Phoebe	Sayornis phoebe	1	0.2
American Crow	Corvus brachyrhynchos	1	0.2
	Total	472	100%

[1] Inappropriate sampling technique.
[2] Non-breeding migrant.
[3] Recorded only as a flyover.

Table 5. Mean number per day (SE) of individuals, species, diversity, and evenness by migratory status for birds recorded at Osotouy, July – August 2003.

		Migratory Status		
Variable	**All Species**	**Resident**	**Migrant**	***P***
Individuals	73.5 (2.14)	28.0 (1.97)	45.5 (2.59)	<0.001
Species	19.3 (0.76)	8.2 (0.75)	11.2 (0.54)	0.009
Diversity	2.695 (0.0348)	1.841 (0.0876)	2.163 (0.0393)	0.012
Evenness	0.911 (0.0043)	0.885 (0.0123)	0.899 (0.0056)	0.187

Table 6. Mean number per day (SE) of individuals, species, diversity, and evenness by nesting guild for birds recorded at Arkansas Post National Memorial, June – July 2003.

	Nesting Guild			
Variable	**Canopy**	**Cavity**	**Shrub**	**Ground**
Individuals	39.8 A[1] (1.25)	12.7 B (1.12)	21.0 C (1.13)	7.7 D (0.67)
Species	9.7 A (0.33)	4.3 B (0.67)	5.2 B (0.31)	1.5 C (0.22)
Diversity	2.069 A (0.0419)	1.119 B (0.1702)	1.328 B (0.0690)	0.200 C (0.0926)
Evenness	0.913 A (0.0079)	0.793 A (0.0328)	0.811 A (0.0195)	0.578 B (0.0750)

[1]Means in the same row followed by the same letter are not different ($P < 0.05$).