

## Avian Surveys along Two River Segments in Southern Indiana

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### Introduction

Bird communities along rivers and streams are infrequently studied due to their relative inaccessibility. Forested areas along waterways may represent the only significant contiguous woodlands in regions of intensive agriculture (1). These areas provide important breeding habitat and travel corridors for avian species that utilize upland and lowland woodlands (1, 2, 5). In an Iowa study, floodplain woodlands supported higher densities of breeding birds than either upland woodland or herbaceous riparian habitats (1,5). Bird species richness increased with the width of the wooded riparian area.

Riparian woodlands are constantly threatened by destruction and modification due to urbanization, channelization, and clearing for agricultural and industrial uses (2). Only 10-14 million ha of the estimated original 30-40 million ha of riparian habitats remain in the contiguous United States (6).

Our objectives were to document bird species present along two rivers in southern Indiana, determine the relative abundance of birds, and compare the avifauna of two waterways that differ in the amount of surrounding forestland. We know of no other systematic surveys of birds along any river segment in Indiana.

### Study Areas and Methods

The 18.5 km segment of Salt Creek was located in Lawrence County and began just east of Guthrie and proceeded south to Oolitic. The put-in on Salt Creek is approximately 4.5 km downstream from the dam of Monroe Reservoir. The survey of the 18.3 km segment of the Patoka River was in Pike County and began just west of state road 257 south of Velpen and flowed northwest to the Pike State Forest. The starting point is over 35 km (aerial distance) from the dam of Patoka Reservoir. Annual flow rates of both river segments are similar (approximately 600 cfs) and are influenced by reservoir practices administered by the U.S. Army Corps of Engineers. Major tree species along Salt Creek and the Patoka River were silver maple (*Acer saccharinum*) and American sycamore (*Platanus occidentalis*). Salt Creek also contained elm (*Ulmus* spp.), boxelder (*Acer negundo*), and basswood (*Tilia americana*). Oaks (*Quercus* spp.), hickories (*Carya* spp.), and river birch (*Betula rubra*) were common along the Patoka River.

Surveys began within 30 minutes of sunrise on days with little wind and no rain. A canoe with an electric motor was used and 2-3 observers were present during each survey, which lasted 4-5 hours depending on the current. The primary author sat in the front of the canoe and counted and recorded all birds seen or heard. The vast majority of birds were detected by sound. No effort was made to estimate densities by determining detectabilities of individual species. Surveys were conducted once annually from 1984-1986 during the first week of June for Salt Creek, while those along the Patoka River were run in mid-June.

The relative amount of woodland adjoining these river segments was estimated from aerial photographs (scale approximately 1:24,000) obtained from the USDA Agricultural Stabilization and Conservation Service and had been taken in 1974 (Patoka River) or

1979 (Salt Creek). For each river segment, 100 random points (out of a possible 1400-1500) were selected for sampling. At each point, the perpendicular distance from the center of the river channel to non-forested habitat on each side was measured. Both distances combined measured the width of the wooded riparian corridor. To determine the relative composition of a 0.4-km corridor along the rivers, 26 points were evaluated at each of the 100 random sampling points. Each point was judged to be either forested or non-forested.

Cluster analyses were performed to determine relationships among the six surveys relative to river segment and year of the survey. Dissimilarities (absolute values of differences and coefficients of determination,  $1 - r^2$ ) were calculated between all 15 combinations of pairs of surveys. Clustering was performed using the Statistical Analysis System software package and single linkage, average linkage, centroid hierarchical, and Ward's minimum variance methods.

### Results and Discussion

The Patoka River contained significantly more ( $P_s < 0.05$ ) woodland (78%) than Salt Creek (38%) within 0.4 km of the stream channel. The median perpendicular width of continuous woodland adjoining each stream segment was 117 m for Salt Creek and 844 m for the Patoka River ( $P_s < 0.05$ ). The median perpendicular distance from the stream channel to the nearest non-forested habitat was 42 m for Salt Creek and 319 m for the Patoka River ( $P_s < 0.05$ ). These distance figures actually underestimated the differences of continuous woodland habitat between river systems. In the Patoka River area, woodlands were broken primarily by narrow corridors such as roads and utility right-of-ways. In contrast, riparian woodlands along Salt Creek were bordered by cultivated fields.

A total of 77 avian species was detected on the six surveys (Table 1). Mean species

TABLE 1. Birds (no. individuals/10km) detected on canoe surveys of Salt Creek (Lawrence County) and Patoka River (Pike County), Indiana, 1984-1986.

Bird species	Salt Creek		Patoka River		P <sup>a</sup>
	Mean	Range	Mean	Range	
No. species/survey	53.3	49.0-58.0	52.0	51.0-54.0	NS
Great blue heron ( <i>Ardea herodias</i> )	0.0		0.5	0.0-1.1	NS
Green-backed heron ( <i>Butorides striatus</i> )	0.2	0.0-0.5	0.0		NS
Yellow-crowned night-heron ( <i>Nycticorax violaceus</i> )	0.0		0.9	0.0-2.2	NS
Wood duck ( <i>Aix sponsa</i> )	42.7	29.7-67.0	11.5	5.5-19.1	NS
Turkey vulture ( <i>Cathartes aura</i> )	0.7	0.0-1.6	0.5	0.0-1.1	NS
Red-shouldered hawk ( <i>Buteo lineatus</i> )	0.0		4.0	3.8-4.4	***
Red-tailed hawk ( <i>Buteo jamaicensis</i> )	1.1	0.0-2.2	0.5	0.0-1.6	NS
Wild turkey ( <i>Meleagris gallopavo</i> )	0.0		0.2	0.0-0.5	NS
Northern bobwhite ( <i>Colinus virginianus</i> )	6.3	2.7-8.6	3.1	1.1-5.5	NS
Killdeer ( <i>Charadrius vociferus</i> )	0.5	0.0-1.1	0.0		NS
Rock dove ( <i>Columba livia</i> )	1.4	0.5-3.2	0.0		NS

TABLE 1.—Continued

Bird species	Salt Creek		Patoka River		P <sup>a</sup>
	Mean	Range	Mean	Range	
Mourning dove ( <i>Zenaida macroura</i> )	3.2	3.2	0.7	0.0-2.2	*
Black-billed cuckoo ( <i>Coccyzus erythrophthalmus</i> )	0.2	0.0-0.5	0.2	0.0-0.5	NS
Yellow-billed cuckoo ( <i>Coccyzus americanus</i> )	1.6	0.0-3.2	7.6	6.0-8.7	**
Great horned owl ( <i>Bubo virginianus</i> )	0.4	0.0-0.5	0.2	0.0-0.5	NS
Barred owl ( <i>Strix varia</i> )	1.6	1.1-2.2	0.9	0.0-1.6	NS
Whip-poor-will ( <i>Caprimulgus vociferus</i> )	0.0		0.2	0.0-0.5	NS
Chimney swift ( <i>Chaetura pelagica</i> )	1.3	0.0-2.2	2.0	0.5-3.8	NS
Ruby-throated hummingbird ( <i>Archilochus colubris</i> )	0.0		4.9	4.4-5.5	***
Belted kingfisher ( <i>Ceryle alcyon</i> )	0.7	0.0-1.6	0.9	0.0-2.2	NS
Red-headed woodpecker ( <i>Melanerpes erythrocephalus</i> )	0.9	0.5-1.1	2.4	0.5-4.9	NS
Red-bellied woodpecker ( <i>Melanerpes carolinus</i> )	3.8	1.6-5.9	4.4	3.8-4.9	NS
Downy woodpecker ( <i>Picoides pubescens</i> )	1.6	0.0-3.2	3.3	1.1-6.0	NS
Hairy woodpecker ( <i>Picoides villosus</i> )	0.7	0.0-2.2	0.4	0.0-0.5	NS
Northern flicker ( <i>Colaptes auratus</i> )	3.4	1.6-6.5	1.3	0.5-1.6	NS
Pileated woodpecker ( <i>Dryocopus pileatus</i> )	2.2	0.5-3.8	5.1	3.3-8.7	NS
Eastern wood-pewee ( <i>Contopus virens</i> )	18.7	17.3-20.5	17.7	13.1-21.8	NS
Acadian flycatcher ( <i>Empidonax virescens</i> )	29.7	29.2-30.8	24.0	22.4-26.2	*
Willow flycatcher ( <i>Empidonax traillii</i> )	0.0		0.4	0.0-0.5	NS
Eastern phoebe ( <i>Sayornis phoebe</i> )	1.1	0.5-2.2	0.7	0.0-1.6	NS
Great crested flycatcher ( <i>Myiarchus crinitus</i> )	2.9	2.2-3.2	6.6	4.9-7.6	*
Eastern kingbird ( <i>Tyrannus tyrannus</i> )	0.7	0.0-1.1	0.5	0.0-1.1	NS
N. rough-winged swallow ( <i>Stelgidopteryx serripennis</i> )	0.2	0.0-0.5	0.4	0.0-1.1	NS
Bank swallow ( <i>Riparia riparia</i> )	0.0		0.2	0.0-0.5	NS
Barn swallow ( <i>Hirundo rustica</i> )	0.0		0.2	0.0-1.1	NS
Blue jay ( <i>Cyanocitta cristata</i> )	10.6	9.2-13.0	8.0	6.0-10.4	NS
American crow ( <i>Corvus brachyrhynchos</i> )	9.2	5.9-14.0	18.9	15.3-23.5	*
Carolina chickadee ( <i>Parus carolinensis</i> )	10.1	4.3-13.5	7.1	3.3-13.1	NS
Tufted titmouse ( <i>Parus bicolor</i> )	21.3	16.8-23.8	18.9	15.8-24.0	NS
White-breasted nuthatch ( <i>Sitta carolinensis</i> )	4.9	1.6-7.6	7.1	6.0-8.2	NS

TABLE 1.—Continued

Bird species	Salt Creek		Patoka River		P <sup>a</sup>
	Mean	Range	Mean	Range	
Carolina wren ( <i>Thryothorus ludovicianus</i> )	0.5	0.5	5.6	1.6-12.0	NS
Blue-gray gnatcatcher ( <i>Poliophtila caerulea</i> )	3.4	1.1-6.5	20.8	16.9-24.0	**
Eastern bluebird ( <i>Sialia sialis</i> )	0.2	0.0-0.5	0.7	0.0-2.2	NS
Wood thrush ( <i>Hylocichla mustelina</i> )	1.3	1.1-1.6	0.4	0.0-1.1	NS
American robin ( <i>Turdus migratorius</i> )	5.4	3.2-8.6	0.7	0.0-1.6	NS
Gray catbird ( <i>Dumetella carolinensis</i> )	1.4	1.1-2.2	0.5	0.0-1.1	NS
Brown thrasher ( <i>Toxostoma rufum</i> )	0.2	0.0-0.5	0.0		NS
Cedar waxwing ( <i>Bombycilla cedrorum</i> )	0.2	0.0-0.5	0.0		NS
European starling ( <i>Sturnus vulgaris</i> )	1.1	0.0-2.2	0.0		NS
White-eyed vireo ( <i>Vireo griseus</i> )	0.7	0.5-1.1	1.8	1.1-2.7	NS
Warbling vireo ( <i>Vireo gilvus</i> )	1.4	1.1-1.6	0.0		**
Red-eyed vireo ( <i>Vireo olivaceus</i> )	6.7	6.5-7.0	12.9	9.3-14.7	*
Northern parula ( <i>Parula americana</i> )	1.8	0.5-3.2	9.1	4.9-12.0	*
Yellow-throated warbler ( <i>Dendroica dominica</i> )	2.9	0.5-5.9	4.7	1.1-7.1	NS
Prairie warbler ( <i>Dendroica discolor</i> )	0.2	0.0-0.5	0.0		NS
Cerulean warbler ( <i>Dendroica cerulea</i> )	0.4	0.0-1.1	9.1	7.1-12.6	**
American redstart ( <i>Setophaga ruticilla</i> )	0.0		5.6	3.8-7.1	**
Prothonotary warbler ( <i>Protonotaria citrea</i> )	11.2	9.7-14.0	19.8	13.7-24.6	NS
Ovenbird ( <i>Seiurus aurocapillus</i> )	0.2	0.0-0.5	0.2	0.0-0.5	NS
Louisiana waterthrush ( <i>Seiurus motacilla</i> )	0.0		0.7	0.0-1.1	NS
Kentucky warbler ( <i>Oporornis formosus</i> )	1.1	0.5-1.6	3.1	2.7-3.8	*
Common yellowthroat ( <i>Geothlypis trichas</i> )	13.9	8.1-17.3	18.2	16.4-19.7	NS
Yellow-breasted chat ( <i>Icteria virens</i> )	0.7	0.5-1.1	2.7	1.1-3.8	NS
Summer tanager ( <i>Piranga rubra</i> )	0.2	0.0-0.5	0.5	0.0-1.6	NS
Scarlet tanager ( <i>Piranga olivacea</i> )	1.1	0.5-1.6	2.2	0.0-4.4	NS
Northern cardinal ( <i>Cardinalis cardinalis</i> )	13.9	9.2-17.8	10.7	9.8-11.5	NS
Indigo bunting ( <i>Passerina cyanea</i> )	24.1	18.4-30.3	35.7	24.6-49.7	NS
Rufous-sided towhee ( <i>Pipilo erythrophthalmus</i> )	0.5	0.0-1.1	1.1	0.0-2.7	NS
Field sparrow ( <i>Spizella pusilla</i> )	0.9	0.0-1.6	0.5	0.0-1.1	NS

TABLE 1.—Continued

Bird species	Salt Creek		Patoka River		P <sup>a</sup>
	Mean	Range	Mean	Range	
Song sparrow ( <i>Melospiza melodia</i> )	4.9	3.8-5.9	0.0		**
Red-winged blackbird ( <i>Agelaius phoeniceus</i> )	8.3	2.7-14.0	1.1	0.5-1.6	NS
Eastern meadowlark ( <i>Sturnella magna</i> )	1.6	0.5-2.7	0.0		NS
Common grackle ( <i>Quiscalus quiscula</i> )	22.7	9.7-33.5	2.7	0.5-5.5	*
Brown-headed cowbird ( <i>Molothrus ater</i> )	5.6	3.2-7.0	8.7	7.6-9.8	NS
Orchard oriole ( <i>Icterus spurius</i> )	0.0		0.2	0.0-0.5	NS
Northern oriole ( <i>Icterus galbula</i> )	1.1	0.0-2.7	0.4	0.0-1.1	NS
American goldfinch ( <i>Carduelis tristis</i> )	1.1	1.1	2.5	2.2-2.7	**

<sup>a</sup>Statistical significance of t tests: NS (P > 0.05), \* (P < 0.05), \*\* (P < 0.01), \*\*\* (P < 0.001).

richness was similar for Salt Creek (mean = 53.3 species) and the Patoka River (mean = 52.0 species). Cluster analyses of surveys produced similar results no matter which clustering method or dissimilarity index was used. Dendrograms generated by each method linked all Salt Creek surveys together and all Patoka River surveys before Salt Creek and Patoka River surveys were combined (Figure 1). Coefficients of determination ( $r^2$ ) for Salt Creek survey pairs ranged from 0.74-0.77 and were 0.74-0.83 for Patoka River pairs. Variation explained using correlations between pairs of Salt Creek and Patoka River surveys ranged from 24-65%. Thus, both waterways have similar avifaunas, but each is distinctive from each other.

Comparisons among bird species should be made with caution due to differences in their detectability. Bird species vary in their degree of conspicuousness and frequency and loudness of vocalizations. Thus, the most commonly detected species may not necessarily have had the greatest population densities. Overall, the most commonly detected species were the indigo bunting (refer to Table 1 for scientific names), wood duck, aca-

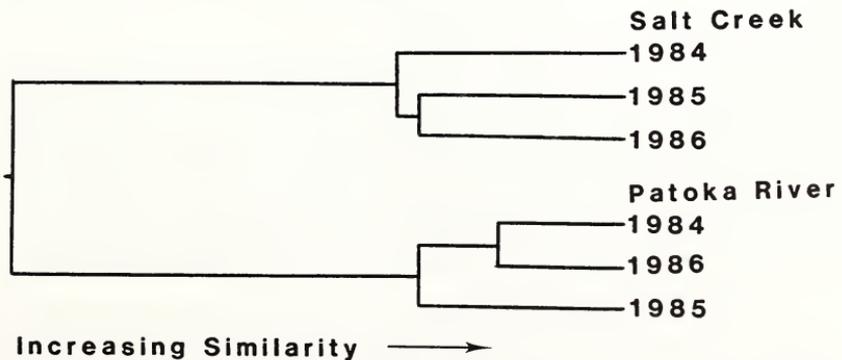


FIGURE 1. Dendrogram showing cluster analysis of six avian surveys, 1984-1986. The average linkage clustering method was used and coefficients of determination ( $1 - r^2$ ) were used as the measure of dissimilarity.

dian flycatcher, tufted titmouse, eastern wood-pewee, common yellowthroat, and prothonotary warbler (Table 1). Only two of these species (wood duck, prothonotary warbler) could be considered wetland obligates. Indigo buntings and common yellowthroats prefer woodland edges and shrublands. Their high rate of occurrence reflects the ecotone provided by the stream channel. The remaining three species are commonly found in upland forests and may obtain high densities along wooded riparian corridors due to the continuity and extent of woodlands.

T-tests between areas for each species showed numbers of individuals detected was significantly greater for twelve species along the Patoka River compared to five species along Salt Creek (Table 1). An additional ten species were unique to the Patoka River and nine other birds were found only along Salt Creek. Generally, species more abundant along the Patoka River were those requiring woodland or woodland edges. Birds whose typical habitats are non-wooded or are associated with man were more commonly found along Salt Creek. A previous study has predicted the impacts of several habitat alterations on birds present in forested riparian areas (5).

Numbers of wood ducks were consistently higher along Salt Creek, although the Patoka River system appears to provide superior habitat. The availability of wetlands away from the Patoka River channel may account for this. Natural oxbows and numerous impoundments of small drainages caused by beaver (*Castor canadensis*) within the last decade are much more prevalent along the Patoka River. Sloughs, oxbows, and flooded timber may offer more optimal production areas for wood ducks compared to river channels subject to restricted flow. Numbers of wood ducks counted along the Patoka River have declined since the construction of Patoka Reservoir. Moser (3) found inverse correlations between breeding indices along streams in Indiana with other independent production estimates. He felt that wood ducks may be forced to use streams to a greater extent when low water levels limit the number of ephemeral wetland habitats elsewhere.

Only two birds found along the stream segments in this study are considered endangered, threatened, or of special concern by the Indiana Division of Fish and Wildlife. The yellow-crowned night-heron is listed as threatened in Indiana and the red-shouldered hawk is of special concern due to loss of wooded riparian habitat. Few nesting sites are presently known for yellow-crowned night-herons in Indiana. They have nested previously along this segment of the Patoka River, but may have abandoned their nest site due to disturbances from mining and the loss of timber from stream modifications conducted by the U.S. Army Corps of Engineers. Used nests recently found away from the stream channel indicate that a population continues to breed along the Patoka River. Although red-shouldered hawks breed in upland forests throughout Indiana, nesting densities are thought to be greatest along the Patoka River.

Both stream segments supported populations of all six woodpecker species that nest in southern Indiana. Discounting the least commonly detected hairy woodpecker, numbers of each woodpecker species, except for the northern flicker, were greater along the Patoka River. Northern flickers prefer the most open and least forested habitats of this group. The higher occurrence rate of the remaining species reflects the greater extent of forest and the number of trees suitable for constructing roosting and nesting cavities. An additional eleven birds in Table 1 utilize cavities for nesting (4). Although patterns of occurrence between stream segments are less clear, the numbers indicate that riparian woodlands are used by many cavity-nesting birds.

A wetland bird species notable for its absence during these surveys was the spotted sandpiper (*Actitis macularia*). This may be due to more constant water flow resulting from the operations of upstream reservoirs, which reduces the number of gravel and sandbars favored by spotted sandpipers.

Although the Patoka River contains a more representative woodland avifauna than

Salt Creek, habitat along the Patoka River has not been free from human disturbances. Much of the woodland adjacent to the Patoka River has been logged within the last decade, but conversion to crop fields has not taken place to any great extent. Mining of coal has occurred in close proximity to the Patoka River. The U.S. Army Corps of Engineers has cleared some sections of log jams and removed some streamside trees. The operation of the dam at Patoka Reservoir will continue to influence the quality of wildlife habitat along the Patoka River. To preserve the diverse wildlife community, protection and management of habitats adjacent to the river channel is necessary.

#### Acknowledgments

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#### Summary

During June 1984-1986, birds were surveyed once annually from a canoe along 18.5 km of Salt Creek, Lawrence County, and 18.3 km of the Patoka River, Pike County, Indiana. A total of 77 avian species was detected and average species richness per survey was similar between river segments (means = 53.3, 52.0). The most commonly detected species were indigo bunting, wood duck, acadian flycatcher, tufted titmouse, eastern wood-pewee, common yellowthroat, and prothonotary warbler. Riparian woodlands provide habitat for a large variety of birds, many of which are uncommon in other habitats. Although both streams shared many birds in common, the number of individuals differed for many species between river segments. The Patoka River supported greater diversity and numbers of woodland species. This is attributed to less encroachment on the riparian corridor by agricultural development and other human activities.

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