Florida Field Naturalist

PUBLISHED BY THE FLORIDA ORNITHOLOGICAL SOCIETY

VOL. 22, NO. 4 NOVEMBER 1994 PAGES 97-128

Fla. Field Nat. 22(4): 97-105, 1994.

AVIFAUNA OF FORESTED WETLANDS ADJACENT TO RIVER SYSTEMS IN CENTRAL FLORIDA

D. L. LEONARD, JR.
Department of Biology, University of Central Florida, P. O. Box 162368, Orlando, Florida 32716
Present Address: *Archbold Biological Station, P. O. Box 2057, Lake Placid, Florida 33862*

Abstract.—Birds were surveyed in forested wetlands bordering blackwater and spring-fed rivers in Orange and Seminole counties, Florida. Nineteen sites were sampled 24 times from September 1991 to August 1992 using point counts. Sixty-nine species were recorded over the 12-month period. The Red-bellied Woodpecker and the Carolina Wren were the most abundant species. Species abundance and diversity were lowest during the summer months. The abundance of 11 species was significantly different between the two forest types. The differences in species abundance and diversity between the forest types in this study and among other studies in central Florida forested wetlands underscore the need for fine-scale quantification of bird species across different geographic regions and habitats in peninsular Florida.

Avian population surveys provide valuable data for comparing species' use of different habitat types within the same and between different regions (Engstrom 1993). They are also one of the first steps in determining the conservation needs of specific habitat types. Published reports of the avifauna using forested wetlands in interior central Florida (Lake, Orange, Osceola, Polk and Seminole counties) are non-existent except for O'Meara's (1984) work in cypress ponds of Osceola County. Species using deciduous wet forests have been quantified in east central Florida (Kale and Webber 1968a, 1968b, 1969a, 1969b, Breininger 1990) and west central Florida (Woolfenden 1967, 1968a, 1968b, Rowher and Woolfenden 1969, Cutright 1981), but these studies may not reflect the species using similar habitats in interior central Florida because of distributional trends outlined by Emlen (1978). In addition, if the goal of habitat conservation is to protect the maximum number of species within a region, information must be available concerning the species' use of different habitat types. Beta diversity measures the change in species across different habitats

within a region (Whittaker 1972). Conservation of areas with high beta diversity will protect more species than protecting different habitats with a high species overlap or with a low beta diversity. Thus, quantitative counts at a finer geographic and habitat scale are necessary to provide researchers and land managers with information on the relative significance of various forested wetlands types to the species using them.

Three divergent circumstances call for the documentation of the species using forested wetlands in interior central Florida. First, the number of species nesting at a given latitude within Florida decreases along a longitudinal gradient from the interior to the coastal areas of the state (Emlen 1978). Therefore, studies conducted in coastal areas would not provide accurate documentation of species using interior forested wetlands at the same latitude. Second, many types of forested wetland types exist and most are extremely diverse and productive (Harris 1989, Ewel 1990), providing important habitat for migratory and resident bird species (Harris and Mulholland 1983). Finally, forested wetlands are being affected directly by anthropogenic habitat encroachment and indirectly by anthropogenic hydrological changes (Brown 1986), despite protective legislation. The objective of this study was to quantify and compare the avifauna using forests bordering blackwater and spring-fed rivers in Orange and Seminole counties, Florida.

Study Areas and Methods

The 19 sites used in this study were located in forested wetlands bordering tributaries of the St. Johns River: the Big and Little Econlockhatchee rivers, Howell Creek, Jim Creek, Mill Creek, Rock Springs Run, Soldier Creek, Tosohatchee Creek, and the Wekiva and Little Wekiva rivers. Mill Creek, Rock Springs Run, and the Wekiva and Little Wekiva rivers are spring-fed; the remainder being blackwater systems. Based on plant species lists and hydrological information provided by FNAI and DNR (1990), all sites were typical of floodplain wetland communities.

The blackwater sites had a less diverse canopy than the spring-fed sites with little shrubby understory and variable but reduced ground cover. Saw palmetto (*Serenoa repens*) was common on the higher areas. Soils were extremely sandy and the sites flooded extensively during the late spring and summer months. Most of these sites were located in east Orange County and were specifically defined as floodplain swamps (FNAI and DNR 1990). Nineteen sampling points were in blackwater forests.

The spring-fed sites had a more diverse tree canopy than the blackwater sites with a dense understory and variable amounts of ground cover. Soils were infrequently flooded and sandy, with considerable organic material accumulation. All of the spring-fed sites were located west of the blackwater sites and were specifically defined as hydric hammock grading into bottomland forests (FNAI and DNR 1990). Sites bordering Soldier Creek were grouped with the spring-fed sites based on their vegetative similarities even though the creek is blackwater in origin. Thirteen sampling points were in spring-fed forest sites. The term forested wetland will be used throughout the rest of this text to reference all the study areas unless otherwise noted.

I used point counts (Blondel et al. 1981) to sample the avian species in the forested wetlands. Thirty-two sampling points were randomly distributed among the 19 sites. The average number of sampling points per site was two. Sampling points were spaced at least 160 meters apart. Points were sampled twice a month from September 1991 to August 1992. All woodland birds seen or heard within a 15-minute period were recorded. All counts were made by the author during mornings with favorable weather conditions and within four hours of sunrise. The order of sampling the points was randomized to reduce any correlations with the time.

Birds were grouped into seasons: winter (Dec, Jan, Feb), spring (Mar, Apr, May), summer (Jun, Jul, Aug), and fall (Sep, Oct, Nov). The Mann-Whitney *U*-test was used to determine if differences in the average individual species' counts differed between forest types. Only species observed at least 30 times were included in the analysis.

RESULTS

Sixty-nine species (6944 individuals) were observed within the 19 sites (Table 1). Both abundance and diversity were minimal during the summer with 1332 individuals of 29 species observed. The greatest abundance was recorded during the spring with a total of 2083 individuals. Species richness was highest during the fall with 61 species.

Few of the species were restricted to forested wetlands. Possible exceptions were the Barred Owl, Acadian Flycatcher, Red-eyed Vireo, Northern Parula and Prothonotary Warbler. Many upland/pine specialists or urban dwellers were observed in narrow sites or those located within a suburban matrix. These species included the Red-headed Woodpecker, Northern Mockingbird, Brown Thrasher, European Starling, and Rufous-sided Towhee.

Permanent residents, species found in central Florida in all four seasons, comprised 69% of the individuals recorded (N=4800 observations). The Red-bellied Woodpecker (N=682), Carolina Wren (N=1109), and Northern Cardinal (N=649) were the most abundant species (Table 1). The Carolina Wren was the most abundant species in the spring, summer, and fall, whereas during the winter the Red-bellied Woodpecker was most abundant. The Red-eyed Vireo (N=150) and the Northern Parula (N=168) were the most abundant Neotropical species breeding in and migrating through the sites. The Ruby-crowned Kinglet (N=89) was the most abundant migratory winter resident.

Of those species showing significant differences ($P < 0.05$) between forest types, only the Belted Kingfisher, Great Crested Flycatcher and the Yellow-throated Warbler were significantly more abundant in the blackwater forest sites (Table 2). The Red-shouldered Hawk, Red-bellied Woodpecker, Northern Flicker, Pileated Woodpecker, Acadian Flycatcher, Carolina Wren, Red-eyed Vireo and Common Grackle were significantly more abundant in the spring-fed sites. No species

Table 1. Species observed within 19 forested wetlands in Orange and Seminole counties, Florida, from September 1991 to August 1992.

Common name	Scientific name	Number of observations				
		Winter	Spring	Summer	Fall	Total
Accipiter sp.	*Accipiter sp.*	1	-	-	4	5
Red-shouldered Hawk	*Buteo lineatus*	83	41	52	88	264
Mourning Dove	*Zenaida macroura*	10	24	11	4	49
Yellow-billed Cuckoo	*Coccyzus americanus*	-	6	25	9	40
Barred Owl	*Strix varia*	12	36	18	16	82
Ruby-throated Hummingbird	*Archilochus colubris*	-	-	6	4	10
Belted Kingfisher	*Ceryle alcyon*	20	1	-	29	50
Red-headed Woodpecker*	*Melanerpes erythrocephalus*	-	1	1	2	4
Red-bellied Woodpecker	*Melanerpes carolinus*	189	159	144	190	682
Yellow-bellied Sapsucker	*Sphyrapicus varius*	61	9	-	22	92
Downy Woodpecker	*Picoides pubescens*	50	31	48	66	195
Hairy Woodpecker**	*Picoides villosus*	1	1	-	2	4
Northern Flicker*	*Colaptes auratus*	17	3	1	12	33
Pileated Woodpecker	*Dryocopus pileatus*	108	84	83	127	402
Eastern Wood-Pewee**	*Contopus virens*	-	-	-	2	2
Acadian Flycatcher	*Empidonax virescens*	-	4	1	40	45
Eastern Phoebe	*Sayornis phoebe*	52	4	-	29	85
Great Crested Flycatcher	*Myiarchus crinitus*	-	50	12	4	66
Blue Jay	*Cyanocitta cristata*	24	18	14	35	91
American Crow	*Corvus brachyrhynchos*	3	3	2	1	9
Fish Crow	*Corvus ossifragus*	2	1	-	5	8
Tufted Titmouse	*Parus bicolor*	126	141	83	99	449
Carolina Wren	*Tryothorus ludovicianus*	169	341	300	299	1109
House Wren**	*Troglodytes aedon*	-	-	-	2	2
Ruby-crowned Kinglet	*Regulus calendula*	89	26	-	31	146
Blue-gray Gnatcatcher	*Polioptila caerulea*	84	159	50	123	416
Veery	*Catharus fuscescens*	-	-	-	18	18
Hermit Thrush	*Catharus guttatus*	6	8	-	5	19
American Robin	*Turdus migratorius*	70	4	-	18	92
Gray Catbird	*Dumetella carolinensis*	7	14	-	33	54
Northern Mockingbird	*Mimus polyglottos*	2	-	4	7	13
Brown Thrasher	*Toxostoma rufum*	1	1	1	-	3
Cedar Waxwing	*Bombycilla cedrorum*	-	8	-	-	8
European Starling**	*Sturnus vulgaris*	-	-	-	1	1
White-eyed Vireo	*Vireo griseus*	16	16	15	46	93
Solitary Vireo	*Vireo solitarius*	43	15	-	8	66
Yellow-throated Vireo**	*Vireo flavifrons*	-	-	-	2	2
Philadelphia Vireo**	*Vireo philadelphicus*	-	-	-	1	1
Red-eyed Vireo	*Vireo olivaceus*	-	181	109	43	333
Blue-winged Warber**	*Vermivora pinus*	-	-	-	1	1
Orange-crowned Warbler	*Vermivora celata*	18	-	-	1	19
Northern Parula	*Parula americana*	22	297	125	57	501
Magnolia Warbler*	*Dendroica magnolia*	-	-	-	1	1
Cape May Warbler	*Dendroica tigrina*	-	2	-	-	2
Black-throated Blue Warbler	*Dendroica caerulescens*	-	20	-	8	28
Yellow-rumped Warbler	*Dendroica coronata*	50	27	-	24	101
Black-throated Green Warbler**	*Dendroica virens*	-	-	-	1	1
Yellow-throated Warbler	*Dendroica dominica*	9	5	-	18	32
Pine Warbler	*Dendroica pinus*	24	18	2	11	55
Bay-breasted Warbler*	*Dendroica castanea*	-	-	-	1	1
Blackpoll Warbler	*Dendroica striata*	-	8	-	-	8
Black-and-white Warbler	*Mniotilta varia*	16	33	3	25	77
American Redstart	*Setophaga ruticilla*	-	36	-	30	66
Prothonotary Warbler	*Protonotaria citrea*	-	1	1	6	8
Worm-eating Warbler	*Helmitheros vermivorus*	-	5	-	6	11
Ovenbird	*Seiurus aurocapillus*	8	9	-	90	107
Waterthrush sp.	*Seiurus sp.*	-	6	2	2	10

Table 1. (Continued)

Common name	Scientific name	Number of observations				
		Winter	Spring	Summer	Fall	Total
Connecticut Warbler**	*Oporornis agilis*	-	1	-	-	1
Common Yellowthroat	*Geothlypis trichas*	-	3	-	3	6
Hooded Warbler*	*Wilsonia citrina*	-	-	-	1	1
Summer Tanager	*Piranga rubra*	-	-	2	3	5
Northern Cardinal	*Cardinalis cardinalis*	107	198	175	169	649
Rufous-sided Towhee	*Pipilo erythrophthalmus*	5	3	-	3	11
Red-winged Blackbird	*Agelaius phoeniceus*	4	4	-	13	21
Boat-tailed Grackle	*Quiscalus major*	-	-	-	5	5
Common Grackle	*Quiscalus quiscalus*	33	17	42	60	152
American Goldfinch	*Carduelis tristis*	21	-	-	-	21
Total number of observations		1563	2083	1332	1966	6994
Total number of species		38	49	29	61	67

*Species observed only in spring-fed sites.
**Species observed only in blackwater sites.

observed greater than 30 times was limited to the blackwater forests, and the Northern Flicker was the only species restricted to the spring-fed forests (Table 1).

DISCUSSION

Seasonal variation in density and species richness of birds associated with forested wetlands in this study was analogous to the findings of other studies in central peninsular Florida (Kale and Webber 1968a, 1968b, 1969a, 1969b, Woolfenden 1967, 1968a, 1968b, Rowher and Woolfenden 1969, Cutright 1981, Breininger 1990). Both density and diversity were greatest during the nonbreeding season. The depauperate breeding fauna of peninsular Florida (Robertson 1955) and the influx of both wintering and migrating species (Stout and Marion 1993) are most likely responsible for this phenomenon. The higher fall diversity was partially due to the greater number of species using migratory routes through central Florida for fall migration when compared to spring (Robertson and Woolfenden 1992). The number of individuals recorded during the spring was at least partially attributable to the greater detectability of both migrants and residents as they began to sing.

The seasonal abundances of the Carolina Wren and Northern Cardinal parallel the finding from coastal areas of central Florida (Kale and Webber 1968a, 1968b, 1969a, 1969b, Woolfenden 1967, 1968a, 1968b, Rowher and Woolfenden 1969, Cutright 1981, Breininger

Table 2. Comparison of the species observed in forests bordering blackwater and spring-fed rivers in Orange and Seminole counties, Florida, from September 1991 to August 1992. Only those species with greater than 30 observations were included.

	Blackwater forest			Spring-fed forest			Mann-Whitney *U*-test	
	N = 19			*N* = 13				
Species	Total	Mean	SD	Total	Mean	SD	Z	*P*
Red-shouldered Hawk	133	7.00	2.26	131	10.08	3.95	-2.59	0.0096
Mourning Dove	42	2.21	3.57	7	0.54	0.97	-1.25	0.2101
Yellow-billed Cuckoo	18	0.95	0.85	22	1.69	2.02	-0.64	0.5210
Barred Owl	45	2.37	2.09	37	2.85	2.91	-0.13	0.8912
Belted Kingfisher	43	2.26	2.75	7	0.54	0.78	-1.89	0.0580
Red-bellied Woodpecker	320	16.84	7.68	362	27.85	5.08	-3.63	0.0003
Yellow-bellied Sapsucker	46	2.42	1.64	46	3.54	2.82	-0.89	0.3694
Downy Woodpecker	114	6.00	2.67	81	6.23	2.98	-0.25	0.8013
Northern Flicker	0	0.00	0.00	33	2.54	1.56	-4.74	0.0001
Pileated Woodpecker	188	9.89	4.97	214	16.46	5.14	-3.05	0.0023
Acadian Flycatcher	16	0.84	0.90	29	2.23	2.39	-2.04	0.0415
Eastern Phoebe	52	2.74	2.54	33	2.54	1.66	-0.06	0.9535
Great Crested Flycatcher	51	2.68	2.26	15	1.15	1.52	-2.13	0.0329
Blue Jay	68	3.58	4.50	23	1.77	1.83	-0.94	0.3487
Tufted Titmouse	261	13.74	8.33	188	14.46	7.04	-0.33	0.7439
Carolina Wren	563	29.63	9.83	545	41.92	9.04	-3.52	0.0004
Ruby-crowned Kinglet	82	4.32	3.56	64	4.92	2.84	-0.52	0.6026
Blue-gray Gnatcatcher	245	12.89	7.25	171	13.15	5.23	-0.42	0.6717
American Robin	47	2.47	1.78	45	3.46	1.81	-1.55	0.1217
Gray Catbird	34	1.79	2.18	20	1.54	1.13	-0.39	0.6933
White-eyed Vireo	72	3.79	4.30	21	1.62	1.61	-1.38	0.1667
Solitary Vireo	42	2.21	2.27	24	1.85	1.99	-0.26	0.7979
Red-eyed Vireo	145	7.63	3.70	188	14.46	5.14	-3.39	0.0007
Northern Parula	283	14.89	5.60	218	16.77	5.42	-0.92	0.3553
Yellow-rumped Warbler	60	3.16	3.15	41	3.15	1.99	-0.72	0.4701
Yellow-throated Warbler	29	1.52	1.87	3	0.23	0.60	-2.43	0.0153
Pine Warbler	41	2.16	2.95	14	1.08	1.75	-1.17	0.2419
Black-and-white Warbler	44	2.32	1.45	33	2.54	2.54	-0.04	0.9683
American Redstart	42	2.21	2.32	24	1.85	1.34	-0.06	0.9532
Ovenbird	51	2.68	1.67	56	4.31	2.32	-1.84	0.0657
Northern Cardinal	371	19.53	9.17	278	21.38	6.54	-0.57	0.5644
Common Grackle	49	2.58	3.79	103	7.92	10.09	-2.01	0.0382

1990). These species as well as many other commonly observed species (Red-bellied Woodpecker, Tufted Titmouse and Blue-gray Gnatcatcher) are not restricted to forested wetlands. This ubiquity may partially explain their abundance (Bock and Ricklefs 1983, Bock 1984). The Blue-gray Gnatcatcher, Red-eyed Vireo and Northern Parula, which were found to be very rare on the east coast (Kale and Webber 1968a, 1968b, 1969a, 1969b, Breininger 1990) and absent from the west coast (Rowher and Woolfenden 1969, but see Woolfenden 1967, 1968a, 1968b) during the breeding season were abundant and ubiquitous in this study. However, other species reported to be common breeding species in central Florida forested wetlands (Rob-

ertson and Woolfenden 1992) were uncommon (Yellow-billed Cuckoo and Acadian Flycatcher) or absent (Prothonotary Warbler) during the breeding season.

The greater abundance of the Belted Kingfisher in blackwater forest areas can be explained by the open canopy of these sites when compared to the spring-fed forest areas. This provided an increased number of hunting perches and greater visibility of the stream or river. The Great Crested Flycatcher was associated with the extensive uplands that bordered most of the blackwater forests. The Yellow-throated Warbler was most often observed foraging along the ecotone between the forested wetlands and the adjacent pine communities. In addition, the blackwater sites were more narrow than the spring-fed sites and this feature may have allowed a greater detectability of those species utilizing the upland-wetland ecotone.

The greater relative abundance of most species within the spring-fed sites may be explained by the greater structural and species diversity of the vegetation when compared to the blackwater sites (MacArthur and MacArthur 1961). Geographic effects may also have contributed to the greater species abundance in the spring-fed sites as all of the blackwater sites were located east of the former. The Red-shouldered Hawk's abundance may be related to the greater contiguous area of the spring-fed forests when compared to the blackwater forests. All five of the woodpecker species included in the analysis were found in greater numbers in the spring-fed sites; however, only three were significantly different. This may have been related to differences in basal area of trees and plant species diversity between the two forest types.

This study confirms the findings of Rowher and Woolfenden (1969) and Emlen (1978), underscoring the importance to conservation decisions of fine scale quantification of the avifauna occurring in complex natural landscapes. Species overlap between the two wetland types was almost complete, and therefore, the beta diversity between the two wetland forest types was low. However, the differences in species' abundance may be important and argues for the protection of both systems. Each system may contribute to the long-run beta diversity of the region especially in the face of anthropogenic fragmentation.

ACKNOWLEDGMENTS

The constructive comments of I. Jack Stout, Peter G. Merritt, Dave Breininger, Leslie K. Backus and an anonymous reviewer were greatly appreciated. I would also like to thank the Department of Environmental Protection and the many private land owners who granted me access to their properties. This work was partially fund by a grant from the Florida Ornithological Society.

LITERATURE CITED

BLONDEL, J., C. FERRY, AND B. FROCHOT. 1981. Point counts with unlimited distance. Studies in Avian Biology 6: 414-420.

BREININGER, D. R. 1990. Avifauna of hammocks and swamps on John F. Kennedy Space Center. Fla. Field Nat. 18: 21-44.

BROWN, M. T. 1986. Cumulative impacts in landscapes dominated by humanity. Pages 33-50 Proceedings of the Conf. Managing Cumulative Effects in Florida Wetlands (E. D. Estevez, J. Miller, J. Morris, and R. Hamman, eds.). New College Env. Studies Program. Pub. # 37 Omnipress, Madison.

CUTRIGHT, N. J. 1981. Bird populations in five major west-central Florida vegetation types. Fla. Sci. 44: 1-13.

EMLEN, J. T. 1978. Density anomalies and regulatory mechanisms in land bird populations on the Florida peninsula. Am. Nat. 112: 265-286.

ENGSTROM, R. T. 1993. Avian communities in Florida habitats: analysis and review. Fla. Game and Fresh Water Fish Comm. Nongame Wildl. Program Final Rep., Tallahassee.

EWEL, K. C. 1990. Swamps. Pages 281-322 *in* Ecosystems of Florida (R.E. Myers and J. J. Ewel, eds.). University of Central Florida Press, Orlando.

HARRIS, L. D. 1989. The faunal significance of fragmentation of southeastern bottomland forests. Pages 126-134 *in* The Forested Wetlands of the Southern United States (D. Hook and R. Lea, eds.). USDA Forest Service, GTR SE-50, Asheville.

HARRIS, L. D., AND R. MULHOLLAND. 1983. Southeastern bottomland ecosystems as wildlife habitat. Proceedings of the 1983 SAF-SFRC. Annual Spring Symposium, Gainesville.

KALE, H. W., II, AND L. A. WEBBER. 1968a. Live oak-cabbage palm hammock. Aud. Field Notes 22:676-680.

KALE, H. W., II, AND L. A. WEBBER. 1968b. Oak-palm-hickory hammock and maple swamp. Aud. Field Notes 22:680-684.

KALE, H. W., II, AND L. A. WEBBER. 1969a. Live oak-cabbage palm coastal hammock. Aud. Field Notes 24:531-533.

KALE, H. W., II, AND L. A. WEBBER. 1969b. Oak-palm-hickory hammock and maple swamp. Aud. Field Notes 24:533-535.

MACARTHUR, R. H., AND J. MACARTHUR. 1961. On bird species diversity. Ecology 42: 494-598.

MYERS, R. L., AND J. J. EWEL. 1990. Ecosystems of Florida. University of Central Florida, Orlando.

FLORIDA NATURAL AREAS INVENTORY AND DEPARTMENT OF NATURAL RESOURCES. 1990. Guide to the natural communities of Florida. Florida Natural Areas Inventory, Tallahassee.

O'MEARA. T. E. 1984. Habitat-island effects on the avian community in cypress ponds. Proc. of the Annu. Conf. of Southeast. Assoc. Fish and Wildl. Agencies 38: 97-110.

ROBERTSON, W. B., JR. 1955. An analysis of breeding-bird populations of tropical Florida in relation to the vegetation. Ph.D. dissertation. University of Illinois, Chicago.

ROBERTSON, W. B., JR. AND G. E. WOOLFENDEN. 1992. Florida bird species, an annotated list. Florida Ornithological Society Special Publication No. 6, Florida Ornithological Society, Gainesville.

ROWHER, S. A., AND G. E. WOOLFENDEN. 1969. Breeding birds of two Florida woodlands: comparisons with areas north of Florida. Condor 71: 38-48.

STOUT, I. J., AND W. R. MARION. 1993. Pine flatwoods and xeric pine forests of the southern (lower) coastal plain. Pages 373-446 *in* Biodiversity of the southeastern United States/lowland terrestrial communities (W. H. Martin, S. G. Boyce, and A. C. Echternacht, eds.). John Wiley and Sons, Inc., New York.

WHITTAKER, R. H. 1972. Evolution and measurement of species diversity. Taxon 21: 213-251.
WOOLFENDEN, G. E. 1967. Live oak-cabbage palm hammock. Aud. Field Notes 21: 635-637.
WOOLFENDEN, G. E. 1968a. Live oak-cabbage palm hammock. Aud. Field Notes 22: 488.
WOOLFENDEN, G. E. 1968b. Live oak-cabbage palm hammock. Aud. Field Notes 22: 684.