Use of floodplain forests by birds during the winter: Implications for floodplain restoration

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INTRODUCTION

Plant communities within floodplain forests are diverse, largely a result of the complexity of habitats (sloughs, oxbow lakes, meander scrolls, and levees) that are characteristic of alluvial plains (Huffman and Forsythe 1981, Pashley and Barrow 1993). The interplay of topography and hydrology is the driving force behind these diverse plant assemblages and natural disturbances such as tree falls and beaver activity add to the natural complexity of alluvial systems. Naturally functioning floodplain forests have been described as a "dynamic mosaic of recovering gaps of many ages across the landscape" (Pashley and Barrow 1993) resulting in forests that are diverse in their composition and structure.

The diversity of plant species in floodplain forests could explain, in part, the high diversity and density of birds that inhabit bottomland forests during the winter (Dickson 1988). An increased diversity of plant species would be especially important if many of the different plants produced either soft or hard mast (e.g., berries or acorns). If bottomland forests contain a relatively high number of woody plant species with the potential to produce mast, they then could provide more predictable and less variable amounts of mast during any given winter than a forest with relatively low species diversity of woody plants (e.g., upland forests). Bark-gleaning winter birds may benefit from the high diversity of woody plant species in bottomland forests if many of the tree species have rough bark. The structural diversity that is characteristic of bottomland forests (Tanner 1986) may provide more substrates for foraging, more food resources, and more cover for birds during the winter than those forests with less complex structure.

The importance of forest tree species composition for avian communities has been documented but not well-studied, especially during the winter period. Most studies of avian-habitat relationships have occurred during the breeding season and have focused on foliage structure (e.g. MacArthur 1958) in habitats of low tree species diversity. Alternatively, evidence indicates that forest tree species composition could have a strong

influence on the bird community (Holmes and Robinson 1981). Previous work in the Cache River Wetlands (CRW) area (including the Cypress Creek NWR and Cache River SNA) indicates that different species of birds have preferences for particular species of trees both during the breeding season and during migration, and that tree species diversity is also important during these periods (A. Gabbe, unpubl. data).

The foraging behavior of winter birds and their preferences for particular species of woody vegetation, however, are not well-documented, and little is known regarding the importance of the composition and structure of bottomland forests for providing available and abundant food for birds during winter. Those studies that have looked at foraging by birds during the winter have focused more on niche segregation (Willson 1970), competitive exclusion (Desrochers 1989), and sex-specific differences (Grubb 1982, Peters and Grub 1983) rather than on the importance of the composition and structure of the plant community. We also lack information on how food resources vary between years, and how this variability subsequently influences the relative abundance and diversity of birds wintering in bottomland forests. Finally, we lack standardized estimates of the relative abundances of winter birds. With standardized estimates of relative abundances, we would be able to make meaningful comparisons between years as well as between different habitat types within a given year, allowing us to document annual variation and habitat associations.

The CRW restoration project in southern Illinois, including the Cypress Creek NWR, provides an excellent opportunity to study the importance of floodplain forests for winter birds, and to incorporate results from research directly into management plans and the restoration process. The loss of bottomland hardwoods is nearly five times higher than for any other major hardwood forest type (Abernethy and Turner 1987) and has been especially severe in the lower Mississippi River Alluvial Valley. Substantial remnant patches of bottomland forest such as those in the CRW may prove important and possibly critical for species such as the Red-shouldered Hawk (see Table 2 for scientific names), Northern Flicker, Red-headed Woodpecker, Yellow-bellied Sapsucker, Pileated

Woodpecker, Brown Creeper, Winter Wren, Golden-crowned Kinglet, Hermit Thrush, American Robin, Swamp Sparrow, Rusty Blackbird, and Purple Finch that all use bottomland forests heavily during the winter.

Based on the first six years of data from the Cypress Creek Christmas Bird Count (CCCBC) (1993-1998), the total number of individual birds observed has varied greatly from year to year for several species (Table 1). The CCCBC occurs on only one day each year and the resulting totals are often influenced by between-year differences in the weather (temperature and precipitation) and/or the effort of the participants (number of participants, coverage of different habitats) on that one day. It is likely, however, that other factors (e.g., food availability) play an even more important role in the between-year variability in the number of birds because the variability is large for many species (Table 1). This project provides the opportunity to study the birds wintering in bottomland forests, to document their diversity and abundance and compare these to upland forests, and to gather information on the factors influencing the between-year fluctuations in diversity and abundance.

With standardized winter bird censuses and documentation of foraging behavior, we addressed several questions regarding winter bird populations in the CRW: 1) Do winter bird populations (diversity and relative abundance) differ between floodplain and upland forests? 2) What foraging tactics, food resources, and tree/shrub species are used by different species of wintering birds? 3) How much between-year variation in winter bird populations is there, and what factors influence this variation the most? 4) How will the restoration of floodplain forests in the CRW influence winter bird populations?

OBJECTIVES

(1) Gather standardized winter census data for comparison with future data to address longer-term questions regarding between-year variation in relative

abundances of winter birds, and the influence of floodplain forest restoration on the winter bird community.

(2) Document the diversity and relative abundance of winter birds and compare these between floodplain and upland forests.

(3) Determine the general foraging tactics, and food resources used by different species of birds wintering in the CRW.

(4) Identify species of trees/shrubs that appear to be important to birds wintering in floodplain forest.

(6) Identify species/habitat associations for those birds wintering in floodplain and adjacent upland forests.

(7) Use these data to provide recommendations for management and restoration of floodplain/bottomland forests in the Cypress Creek NWR and the CRW.

METHODS

In January, February, and early March of 1999 within the Cypress Creek NWR and CRW, we censused approximately 250 and 140 points in floodplain and upland forest habitat, respectively. Each census point was placed into one of 18 bottomland or 9 upland forest categories based on composition of the forest, topography, and hydrology (see Table 2 for list of habitat types). We conducted a 6-minute point count at each census point (Ralph et al. 1995), that was modified to take into account flocks of wintering birds (location of flock center, size and composition of flock). We visited most census point 2 times during the 2-month period. We noted the weather conditions on each day of censussing. Within the floodplain forest, we visited most pre-existing census points (established during the summer of 1993) including those in small (<20 ha) isolated woodlots and those in large (>2,000 ha) contiguous forests within the CRW. Censuses of upland forests were restricted to those occurring in the Cache River Watershed, and a few areas within the western portion of the Shawnee National Forest.

We made general observations of birds foraging after the completion of some census points. We documented the species of tree/shrub each focal bird was located in, and followed these individuals for up to 5 minutes. With a second year of data we will make detailed comparisons of use vs. availability for different tree species and various species of birds.

RESULTS AND DISCUSSION

The first year of winter research (winter 1999) has established the importance of bottomland forests for wintering birds. Compared to upland forests, bottomland forests contain nearly five times the number of individual birds during the winter. This vast difference is a result of a greater diversity of avian species (58 vs. 35 species recorded in bottomland and upland forests, respectively) and greater abundances (for a given species) in the bottomland forests (see Table 2 AllBF vs. AllUF categories). Also, the bottomland forests appear to be providing critical winter habitat (>90% of all individuals found in bottomland forest rather than upland) for some species for which there is concern (e.g., Red-headed Woodpecker, Brown Creeper, Rusty Blackbird, and Winter Wren).

The data also suggest the importance of particular species of trees during the winter, and some of these species are not considered to be important during the breeding season. For example, the acorn mast from Pin and Cherry-bark Oak within a 500 hectare area of forest (Section 11 Woods near Horseshoe Lake) was the catalyst for possibly the highest density of Red-headed Woodpeckers ever recorded (more than 4 per hectare over several hundred hectares). We also observed thousands of Rusty Blackbirds foraging on the acorns in this forest. Areas within the watershed lacking these oak species or where the acorn mast was not substantial had few individuals of these two species of bird. Species of tree with rough or deeply furrowed bark (e.g., Green Ash, American Elm, Tupelo, Hackberry) were used extensively by Brown Creepers during the winter, but were not necessarily preferred by other species of bird during the breeding season.

There were other habitat associations found for some species using bottomland forest during the winter. Winter wrens were especially numerous along the edges of Tupelo and mixed-species swamps, and were usually seen hopping about on downed trees or natural brush piles at the waters edge. Brown Creepers were most common along the edge of and out into swamps that were primarily Tupelo. Golden-crowned Kinglets were unusually numerous in bottomland forest that was within 100m of the Cache River. It will require more years of observations and censuses to determine why these particular associations exist (e.g., presence of water, particular tree species, food resource, etc.) and whether or not these associations are prevalent over several years.

Subsequent research will involve gathering more years of standardized winter census data for both floodplain and adjacent upland forests within the CCNWR and Cache River watershed. These data will be used to address longer-term questions regarding how relative abundances of winter birds vary between years, how these values compare to Christmas Bird Count data, and how the restoration of floodplain forests influences the winter bird community. We will also use this data to determine how consistently the diversity and relative abundances of winter birds differ between floodplain and adjacent upland forests, and to identify the specific bottomland forest habitats that are especially important for winter birds that are species of concern. This research will increase our ability to effectively and efficiently restore and manage floodplain forests and will ultimately provide the greatest benefit to the avian community year-round. The results of this research have broad application in the Mississippi Ecoregions and will assist with other floodplain forest restoration efforts throughout the United States.

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Table 1. High and low count totals for some species of birds wintering in Southern Illinois (based on Cypress Creek Christmas Bird Count data, 1993-1998).

Species	High count	Low count
Red-headed Woodpecker	738	9
Red-bellied Woodpecker	201	36
Yellow-bellied Sapsucker	11	2
Pileated Woodpecker	84	13
Brown Creeper	19	4
Winter Wren	17	0
Golden-crowned Kinglet	166	36
Ruby-crowned Kinglet	29	1
Hermit Thrush	93	0
American Robin	53,079	3
Yellow-rumped Warbler	203	2
Eastern Towhee	40	3
American Tree Sparrow	267	64
Field Sparrow	299	14
Savannah Sparrow	46	0
Fox Sparrow	50	1
Song Sparrow	627	95
Swamp Sparrow	573	34
White-throated Sparrow	1,076	74
White-crowned Sparrow	392	19
Rusty Blackbird	1,500	0
Purple Finch	42	0
Pine Siskin	17	0

Table 2. Abundances (Number of individuals per 70-m radius census point) of birds during the winter (January to March) in various forested habitats in southern Illinois, 1999.

	Habitat[a]						
Species[b]	FF (78)[c]	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
SNGO	FO[d]	FO	FO	FO	FO	----	----
ROGO	----	FO	FO	----	----	----	----
WFGO	FO	----	FO	----	----	----	----
CAGO	FO	FO	FO	0.008	FO	----	----
AMBD	----	----	----	----	----	----	----
MALL	FO	**0.111(144)**[e]	0.065(144)	0.071(10)	0.120(22)	P[f]	----
COPI	----	----	----	----	----	----	----
AMWI	----	----	----	----	----	----	----
WODU	0.064	0.065	0.065	0.260(2)	0.220	0.276	P
REDH	----	----	----	----	----	----	----

Species	Habitat						
	FF (78)	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
HOME	----	----	----	FO	----	----	----
RBGU	----	----	----	----	----	----	----
GBHE	----	0.009	0.005	0.055	0.040	----	----
KILL	FO	FO	FO	FO	FO	FO	----
AMWO	----	----	----	0.008	----	----	----
SSHA	0.013	----	0.005	----	FO	0.034	----
NOHA	----	----	----	----	----	----	----
RTHA	FO	0.009	0.005	0.008	----	FO	----
RSHA	0.128	0.083	0.102	0.126	0.020	0.034	0.045
BAEA	----	----	----	----	----	----	----
TUVU	P	----	P	FO	FO	FO	----
BLVU	FO	----	FO	0.016	0.080	FO	FO
AMKE	0.013	----	0.005	0.016	FO	----	----

Species	Habitat						
	FF (78)	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
SCOW	----	----	----	----	0.020	----	----
GHOW	----	----	----	----	----	----	0.045
BAOW	0.077	0.028	0.048	0.016	----	P	----
MODO	----	----	----	0.008	----	----	----
BEKI	0.013	0.009	0.011	0.024	----	----	0.091
RHWO	0.449	**6.176**	3.774	0.197	0.160	0.276	0.136
PIWO	0.192	0.120	0.151	0.252	0.300	0.207	0.091
COFL	0.410	0.157	0.263	0.213	0.120	0.069	0.045
RBWO	0.436	0.398	0.414	0.252	0.340	0.207	0.136
YBSA	0.013	0.009	0.011	----	----	----	----
DOWO	0.667	1.019	0.871	0.614	0.560	0.655	0.364
HAWO	0.526	0.269	0.376	0.480	0.760	0.655	0.455
EAPH	----	----	----	----	0.040	0.034	----

Species	Habitat						
	FF (78)	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
HOLA	FO	----	FO	FO	----	----	----
FICR	----	0.009	0.005	0.032	----	----	----
AMCR	0.167	0.083	0.118	0.118	0.140	0.172	P
BLJA	0.244	**1.907**	1.210	0.181	P	0.103	0.091
CACH	2.115	1.944	2.016	2.197	2.320	1.724	2.955
ETTI	1.385	**4.821**	3.382	1.370	0.900	0.862	1.864
WBNU	1.256	1.306	1.285	1.496	1.220	1.379	1.909
BRCR	0.808	0.556	0.661	0.551	**1.120**	0.276	0.455
HOWR	----	----	----	0.008	0.040	----	----
WIWR	0.372	0.231	0.290	**0.811**	**1.160**	0.414	0.545
CAWR	0.833	0.583	0.688	0.740	0.780	0.655	0.955
RCKI	0.026	0.019	0.022	0.008	----	0.034	----
GCKI	0.641	0.870	0.774	0.677	0.660	0.552	**1.364**

Species	Habitat						
	FF (78)	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
EABL	0.077	0.037	0.054	0.220	0.260	0.103	0.182
AMRO	0.026	0.028	0.027	0.016	FO	----	----
HETH	0.103	0.009	0.048	0.094	0.120	0.138	----
YRWA	0.295	0.130	0.199	0.165	0.120	0.345	0.273
RWBL	P	P	P	0.016	FO	----	FO
BHCO	0.013	0.009(20)	0.011(10)	0.008	----	----	----
RUBL	0.231(9)	**0.352(147)**	0.301(103)	0.055(3)	0.200(3)	----	FO
COGR	0.051(99)	**0.222(494)**	0.151(437)	0.016	FO	P	----
EAME	----	----	----	PF[g]	----	----	----
EUST	----	P	P	0.008	0.040	----	----
DEJU	P	0.102	0.059	0.087	----	0.034	----
NOCA	0.269	0.065	0.151	0.205	0.080	0.207	0.182
HOFI	----	----	----	----	----	----	----

Species	Habitat						
	FF (78)	SEWFF (108)	AllFF (186)	FFMS (127)	FFTS (50)	RL (29)	FFR (22)
PUFI	0.013	----	0.005	0.016	----	----	----
AMGO	0.718	0.259	0.452	0.339	0.500	0.345	0.591
EATO	----	----	----	----	----	----	----
WTSP	0.218(6)	0.167(2)	0.188(4)	0.110	0.060	0.414	0.182
WCSP	0.013	----	0.005	----	----	----	----
FISP	----	----	----	----	----	----	----
SWSP	0.013(5)	----	0.005(5)	0.016	0.040	----	0.045
ATSP	0.013	----	0.005	----	----	----	----
FOSP	----	0.009	0.005	P	----	0.379	----
SOSP	0.039(11)	----	0.016(11)	0.008	0.060	----	----
LISP	----	----	----	----	0.020	----	----
TOTAL SPECIES[h]	41	39	47	47	34	31	25

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
SNGO	FO	----	----	----	----	FO	----
ROGO	----	----	----	----	----	----	----
WFGO	----	----	----	----	----	----	----
CAGO	FO	P	FO	----	----	0.125	P
AMBD	----	----	----	----	----	----	----
MALL	P	0.353(12)	----	P	P	FO	0.333
COPI	----	----	----	----	----	----	----
AMWI	----	----	----	----	----	----	FO
WODU	----	----	0.200	FO	0.667	----	0.111
REDH	----	----	----	----	----	----	----
HOME	----	----	----	----	----	----	FO
RBGU	----	----	----	----	----	----	----
GBHE	P	0.059	----	----	----	----	----

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
KILL	----	FO	----	----	FO	FO	FO
AMWO	----	----	----	----	----	----	----
SSHA	----	----	----	----	----	----	----
NOHA	----	FO	----	----	----	----	----
RTHA	----	0.059	----	----	----	0.125	FO
RSHA	0.056	0.059	0.100	P	P	0.125	0.222
BAEA	----	----	----	----	----	----	FO
TUVU	FO	----	0.200	FO	FO	----	----
BLVU	----	----	0.600	0.333	P	----	----
AMKE	----	----	----	----	----	----	0.111
SCOW	----	----	----	----	----	----	----
GHOW	----	----	----	----	----	----	----
BAOW	0.111	----	0.100	----	----	----	0.222

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
MODO	----	----	----	----	----	----	----
BEKI	----	----	----	----	----	0.125	----
RHWO	0.056	0.118	----	----	0.167	0.375	----
PIWO	P	0.118	0.300	0.167	0.667	P	0.222
COFL	0.500	----	----	0.167	0.167	0.125	0.222
RBWO	0.500	0.235	0.400	0.500	0.333	0.250	0.556
YBSA	----	----	----	----	----	----	----
DOWO	0.500	0.118	0.700	0.333	1.000	1.000	0.778
HAWO	0.167	0.765	0.400	0.167	0.500	0.375	0.222
EAPH	0.111	----	----	----	0.333	----	----
HOLA	PF	----	----	----	----	----	FO
FICR	----	----	----	----	----	----	----
AMCR	0.056	P	0.100	0.333	0.167	P	P

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
BLJA	0.222	P	----	0.167	0.500	0.125	----
CACH	1.667	2.235	2.200	2.000	3.333	1.875	3.556
ETTI	0.444	0.882	1.200	1.667	0.833	----	1.444
WBNU	0.389	0.412	1.800	2.167	1.833	0.750	1.111
BRCR	0.667	0.412	0.700	0.667	0.500	----	0.889
HOWR	----	----	----	----	0.167	----	----
WIWR	0.444	0.294	0.900	1.500	1.500	----	0.222
CAWR	0.444	0.529	0.500	0.833	1.000	0.750	0.667
RCKI	----	----	----	----	----	----	0.111
GCKI	0.889	0.647	0.400	0.167	3.333	0.375	3.000
EABL	0.111	----	0.300	----	0.167	0.500	----
AMRO	----	----	----	----	----	0.250	----
HETH	----	----	0.100	----	----	----	----

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
YRWA	0.111	0.059	----	----	0.167	----	2.556
RWBL	FO	P	----	----	0.167	P	FO
BHCO	----	----	----	----	----	----	----
RUBL	----	----	----	----	P	FO	----
COGR	0.056	FO	----	FO	P	FO	----
EAME	PF	PF	----	----	----	PF	----
EUST	----	----	----	----	0.667	----	----
DEJU	0.167	0.059(15)	----	----	0.333(15)	0.250	----
NOCA	0.444	0.235	----	0.167	0.333	0.125	P
HOFI	----	----	----	----	----	----	----
PUFI	----	----	----	----	----	----	----
AMGO	0.333	0.647	0.400	0.333	0.333	0.500	----
EATO	P	----	----	----	----	----	----

Species	Habitat						
	FFField (18)	FFMSS (17)	FFCTS (10)	FFTCS (6)	FFOS (6)	FFFrag (8)	RC (9)
WTSP	0.167	0.353	----	----	1.500	0.375	----
WCSP	----	----	----	----	----	----	----
FISP	----	----	----	----	----	----	----
SWSP	----	0.235	----	----	1.000	0.125	----
ATSP	----	0.059	----	----	----	----	----
FOSP	----	0.059	----	0.167	----	----	0.111
SOSP	----	0.059	----	0.167	1.000(2)	0.250	0.111
LISP	----	----	----	----	----	----	----
TOTAL SPECIES	28	29	20	21	33	25	23

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
SNGO	----	FO	----	FO	----	----	----
ROGO	----	----	----	----	----	----	----
WFGO	----	----	----	----	----	----	----
CAGO	P	----	FO	----	----	----	----
AMBD	----	----	----	----	----	----	----
MALL	----	0.400	----	----	0.500(50)	----	FO
COPI	----	FO	----	----	----	----	----
AMWI	----	FO	----	----	----	----	----
WODU	----	0.200	1.000	----	1.000(5)	----	----
REDH	----	FO	----	----	----	----	----
HOME	----	----	----	----	0.500	----	----
RBGU	----	----	----	----	----	----	----
GBHE	----	----	----	----	----	----	----

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
KILL	----	FO	----	----	----	----	----
AMWO	----	----	----	----	----	----	----
SSHA	----	----	----	----	----	----	----
NOHA	----	FO	----	----	----	----	----
RTHA	----	P	----	----	----	----	----
RSHA	0.167	FO	----	----	P	----	----
BAEA	----	----	----	----	----	----	FO
TUVU	----	----	0.500	FO	----	FO	FO
BLVU	----	----	0.500	FO	----	----	----
AMKE	----	P	----	----	----	----	----
SCOW	----	----	----	----	----	----	----
GHOW	----	----	P	----	----	----	----
BAOW	----	----	----	----	----	----	----

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
MODO	----	----	----	----	----	----	----
BEKI	----	----	----	----	----	----	----
RHWO	P	----	----	----	----	0.500	----
PIWO	0.167	P	1.000	1.000	P	0.500	P
COFL	0.500	0.400	----	----	----	----	P
RBWO	----	----	1.000	----	0.500	----	0.143
YBSA	----	----	----	----	----	----	----
DOWO	0.833	P	1.500	2.000	0.500	P	0.143
HAWO	0.833	0.200	----	0.500	0.500	0.500	0.429
EAPH	----	----	----	----	----	----	----
HOLA	----	FO	----	----	----	----	----
FICR	----	----	----	----	----	----	----
AMCR	0.333	P	0.500	P	----	----	0.143

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
BLJA	0.167	P	----	1.000	----	----	P
CACH	2.000	1.200	3.500	2.500	3.500	3.000	0.857
ETTI	1.833	0.200	3.000	3.000	1.500	3.000	0.571
WBNU	0.833	0.400	2.500	1.000	2.500	2.000	0.857
BRCR	0.500	0.400	1.000	1.500	2.000	----	0.286
HOWR	----	----	----	----	----	----	----
WIWR	1.333	----	0.500	0.500	1.000	0.500	----
CAWR	0.333	P	----	1.000	0.500	0.500	0.429
RCKI	----	----	----	----	----	----	----
GCKI	0.333	0.200	1.500	2.000	1.000	1.000	0.286
EABL	0.333	----	0.500	0.500	----	0.500	----
AMRO	----	----	----	----	----	----	----
HETH	0.500	----	----	----	----	0.500	----

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
YRWA	----	1.400	----	----	----	----	----
RWBL	FO	0.200	----	----	0.500(25)	----	0.143
BHCO	----	----	----	----	----	----	----
RUBL	----	----	----	----	0.500(250)	----	----
COGR	----	FO	----	----	----	----	----
EAME	----	----	----	----	----	----	----
EUST	----	FO	----	----	----	----	----
DEJU	----	----	----	0.500	----	----	----
NOCA	----	----	----	0.500	1.000	1.000	----
HOFI	----	----	----	----	----	----	----
PUFI	----	----	----	----	----	----	----
AMGO	0.333	----	----	----	0.500	1.000	----
EATO	----	----	----	----	----	----	----

Species	Habitat						
	RLS (6)	BBS (5)	CS (2)	FFCS (2)	FFMSCane (2)	FFRCane (2)	FF/UF (7)
WTSP	----	----	----	----	1.000(14)	1.000	----
WCSP	----	----	----	----	----	----	----
FISP	----	----	----	----	----	----	----
SWSP	----	----	----	----	2.000	----	----
ATSP	----	----	----	----	----	----	----
FOSP	----	----	----	----	----	----	----
SOSP	----	----	----	----	1.500	----	----
LISP	----	----	----	----	----	----	----
TOTAL SPECIES	19	18	15	15	22	15	14

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
SNGO	----	----	FO	FO	FO	FO	----
ROGO	----	----	----	----	----	----	----
WFGO	----	----	----	----	----	----	----
CAGO	----	P	FO	FO	FO	FO	FO
AMBD	----	----	FO	----	----	----	----
MALL	----	FO	P	----	----	FO	FO
COPI	----	----	FO	----	----	----	----
AMWI	----	----	----	----	----	----	----
WODU	0.500	----	----	FO	----	----	----
REDH	----	FO	----	----	----	----	----
HOME	----	----	P	----	----	----	----
RBGU	----	FO	----	FO	----	----	----
GBHE	----	----	----	----	----	----	----

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
KILL	----	----	FO	FO	----	----	FO
AMWO	----	----	----	0.026	----	----	----
SSHA	----	----	0.007	----	----	----	----
NOHA	----	----	----	----	----	----	----
RTHA	----	----	FO	FO	FO	FO	----
RSHA	P	----	0.007	P	----	0.036	P
BAEA	----	----	----	----	FO	----	----
TUVU	----	----	FO	FO	----	----	FO
BLVU	----	----	FO	----	----	----	FO
AMKE	----	----	----	----	----	FO	----
SCOW	----	----	----	----	----	----	----
GHOW	----	----	----	P	----	----	----
BAOW	P	----	0.014	----	----	----	P

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
MODO	----	----	----	----	----	----	----
BEKI	----	----	----	----	----	----	----
RHWO	0.500	----	----	----	----	----	----
PIWO	0.500	----	0.055	0.064	P	0.071	P
COFL	0.500	----	0.027	0.154	----	0.107	----
RBWO	----	----	0.075	0.115	P	0.036	P
YBSA	----	----	0.007	----	----	0.036	----
DOWO	----	1.000	0.178	0.231	0.176	0.214	----
HAWO	1.000	0.500	0.226	0.269	0.059	0.143	0.167
EAPH	----	----	0.014	----	----	----	----
HOLA	----	----	FO	----	----	FO	----
FICR	----	----	FO	----	----	----	----
AMCR	P	P	0.041	0.013	P	0.036	0.083

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
BLJA	----	P	0.027	0.090	P	0.143	P
CACH	1.000	3.000	0.562	0.885	0.765	1.500	0.333
ETTI	1.500	1.000	0.171	0.500	0.118	0.179	0.250
WBNU	1.000	1.500	0.260	0.282	0.471	0.286	P
BRCR	1.000	0.500	0.116	0.167	0.059	0.107	----
HOWR	----	----	----	----	----	----	----
WIWR	0.500	0.500	0.021	0.205	----	----	----
CAWR	0.500	1.000	0.315	0.500	0.059	0.250	0.167
RCKI	----	----	----	----	----	----	----
GCKI	1.000	----	0.110	0.115	0.176	0.036	0.250
EABL	1.000	0.500	0.014	P	----	0.036	----
AMRO	----	----	----	P	----	----	----
HETH	----	0.500	----	----	----	----	----

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
YRWA	2.000	0.500	0.130	0.026	0.059	0.179	----
RWBL	----	----	FO	FO	FO	FO	----
BHCO	----	----	----	----	----	----	----
RUBL	----	----	FO	FO	----	FO	----
COGR	FO	FO	P	FO	----	FO	FO
EAME	----	----	PF	----	----	----	----
EUST	----	----	----	----	----	----	----
DEJU	----	----	----	0.038	----	----	----
NOCA	0.500	0.500	0.068	0.308	----	0.071	----
HOFI	----	----	0.007	----	----	----	----
PUFI	----	----	----	----	----	----	----
AMGO	FO	2.000	0.041	0.179	0.118	0.393	----
EATO	----	----	----	0.013	----	----	----

Species	Habitat						
	RL/UF (2)	UFRAFF (2)	UF (146)	UFRA (78)	UFRI (17)	UFField (28)	UFYoung (12)
WTSP	----	1.500(4)	----	0.218	----	0.179	----
WCSP	----	----	----	----	----	----	----
FISP	----	----	----	0.038	----	----	----
SWSP	----	----	----	0.038	----	0.036	----
ATSP	----	----	----	----	----	P	----
FOSP	----	----	----	----	----	----	----
SOSP	----	----	P	0.038	----	0.071	0.167
LISP	----	----	----	----	----	----	----
TOTAL SPECIES	18	17	28	28	13	23	13

Species	Habitat	
	TT (4)	Pine (13)
SNGO	----	----
ROGO	----	----
WFGO	----	----
CAGO	----	----
AMBD	----	----
MALL	----	----
COPI	----	----
AMWI	----	----
WODU	----	----
REDH	----	----
HOME	----	----
RBGU	----	----
GBHE	----	----

Species	Habitat	
	TT (4)	Pine (13)
KILL	----	----
AMWO	----	----
SSHA	----	----
NOHA	----	----
RTHA	----	FO
RSHA	----	FO
BAEA	----	----
TUVU	----	FO
BLVU	----	----
AMKE	----	----
SCOW	----	----
GHOW	----	----
BAOW	----	----

Species	Habitat	
	TT (4)	Pine (13)
MODO	----	----
BEKI	----	----
RHWO	----	----
PIWO	P	P
COFL	----	0.077
RBWO	----	0.154
YBSA	----	----
DOWO	----	0.077
HAWO	0.250	P
EAPH	----	----
HOLA	----	----
FICR	----	----
AMCR	----	0.077

Species	Habitat	
	TT (4)	Pine (13)
BLJA	P	P
CACH	1.500	1.000
ETTI	----	0.308
WBNU	----	0.231
BRCR	0.250	----
HOWR	----	----
WIWR	----	----
CAWR	0.500	----
RCKI	----	0.154
GCKI	----	1.846
EABL	----	----
AMRO	----	----
HETH	----	----

Species	Habitat	
	TT (4)	Pine (13)
YRWA	0.500	----
RWBL	----	----
BHCO	----	----
RUBL	----	----
COGR	----	----
EAME	----	----
EUST	----	----
DEJU	----	----
NOCA	0.250	0.077
HOFI	----	----
PUFI	----	----
AMGO	----	P
EATO	----	----

Species	Habitat	
	TT (4)	Pine (13)
WTSP	----	0.077
WCSP	----	----
FISP	----	----
SWSP	----	----
ATSP	----	----
FOSP	----	----
SOSP	----	----
LISP	----	----
TOTAL SPECIES	8	15

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
SNGO	FO	FO	FO
ROGO	FO	FO	----
WFGO	----	FO	----
CAGO	FO	0.004	FO
AMBD	----	----	FO
MALL	**0.111(144)**	**0.077(54)**	FO
COPI	----	FO	FO
AMWI	----	FO	----
WODU	0.065	**0.150(2)**	FO
REDH	----	FO	----
HOME	----	0.002	P
RBGU	----	----	FO
GBHE	0.009	**0.022**	----

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
KILL	FO	FO	FO
AMWO	----	0.002	0.007
SSHA	----	0.004	0.004
NOHA	----	FO	----
RTHA	0.009	0.008	FO
RSHA	0.083	**0.087**	0.007
BAEA	----	FO	FO
TUVU	----	0.006	FO
BLVU	----	**0.030**	FO
AMKE	----	0.008	FO
SCOW	----	0.002	----
GHOW	----	0.002	P
BAOW	0.028	**0.032**	0.007

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
MODO	----	0.002	----
BEKI	0.009	0.002	----
RHWO	**6.176**	**1.485**	----
PIWO	0.120	**0.199**	0.053
COFL	0.157	**0.205**	0.067
RBWO	0.398	**0.329**	0.074
YBSA	0.009	0.004	0.007
DOWO	1.019	**0.688**	0.189
HAWO	0.269	**0.465**	0.217
EAPH	----	0.014	0.007
HOLA	----	PF	FO
FICR	0.009	**0.010**	FO
AMCR	0.083	0.112	0.078

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
BLJA	**1.907**	**0.574**	0.053
CACH	1.944	**2.163**	0.748
ETTI	**4.821**	**1.992**	0.263
WBNU	1.306	**1.303**	0.270
BRCR	0.556	**0.635**	0.121
HOWR	----	0.008	----
WIWR	0.231	**0.580**	0.068
CAWR	0.583	**0.692**	0.338
RCKI	0.019	**0.014**	----
GCKI	0.870	**0.775**	0.114
EABL	0.037	**0.144**	0.011
AMRO	0.028	**0.018**	P
HETH	0.009	**0.071**	----

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
YRWA	0.130	**0.219**	0.096
RWBL	P	**0.010(6)**	FO
BHCO	0.009(20)	0.002(7)	----
RUBL	**0.352(147)**	**0.146(81)**	FO
COGR	**0.222(494)**	**0.061(388)**	FO
EAME	----	PF	PF
EUST	P	0.014	----
DEJU	0.102	**0.063(2)**	0.011
NOCA	0.065	0.176	0.128
HOFI	----	----	0.004
PUFI	----	0.006	----
AMGO	0.259	**0.412**	0.117
EATO	----	P	0.004

Species	Habitat		
	SEW (108)	AllBF (507)	AllUF (281)
WTSP	0.167(2)	**0.183(2)**	0.078
WCSP	----	0.002	----
FISP	----	----	0.011
SWSP	----	**0.041**	0.014
ATSP	----	0.004	P
FOSP	0.009	**0.029**	----
SOSP	----	**0.041(3)**	0.025
LISP	----	0.002	----
TOTAL SPECIES	39	58	35

[a] FF = Generic floodplain forest with no specific topographic or hydrologic feature.
SEWFF = Section 11 Woods study site floodplain forest.
AllFF = FF + SEWFF
FFMS = Interface of floodplain forest and forested swamps containing mixed species of trees.
FFTS = Interface of floodplain forest and forested swamps containing Tupelo trees.
RL = Natural river levee along the Cache River.
FFR = Floodplain forest not on the natural river levee, but within 100 m of the Cache River.
FFField = Floodplain forest adjacent to (census points < 100 m from) non-agricultural fields.
FFMSS = Interface of floodplain forest and a slough containing mixed species of trees and shrubs.
FFCTS = Interface of floodplain forest and forested swamps containing Tupelo but dominated by Baldcypress.
FFTCS = Interface of floodplain forest and forested swamps containing Baldcypress but dominated by Tupelo.
FFOS = Interface of floodplain forest and open-water swamp containing no living trees.
FFFrag = Small (< 10 ha) fragments of floodplain forest.
RC = The middle of the Cache River channel.
RLS = Interface of natural river levee and forested swamp.
BBS = Deep water Buttonbush swamp with scattered Tupelo and Baldcypress.
CS = Baldcypress swamp.
FFCS = Interface of floodplain forest and Baldcypress swamp.
FFMSCane = FFMS with dense stands of Cane present.
FFRCane = FFR with dense stands of Cane present.
FF/UF = Interface of floodplain and upland forest.
RL/UF = Interface of natural river levee and upland forest.
UFRAFF = Interface of upland and floodplain forest within a ravine.
UF = Generic upland forest with no specific topographic feature.
UFRA = Upland forest within a ravine.
UFRI = Upland forest on a ridge top.
UFField = Upland forest adjacent to (census points < 100 m from) non-agricultural fields.
UFYoung = Regenerating (20-30 year-old) upland forest.
TT = Tulip tree (Tulip Poplar) plantation.
Pine = Non-native pine plantations.
AllBF = All bottomland forest (habitats AllFF through FFRCane combined) habitat.
AllUF = All upland forest (habitats UF through UFYoung combined) habitat.

b AMBD = American Black Duck (*Anas rubripes*)
AMCR = American Crow (*Corvus brachyrhynchos*)
AMGO = American Goldfinch (*Carduelis tristis*)
AMKE = American Kestrel (*Falco sparverius*)
AMRO = American Robin (*Turdus migratorius*)
AMWI = American Widgeon (*Anas americana*)
ATSP = American Tree Sparrow (*Spizella arborea*)
BAEA = Bald Eagle (*Haliaeetus leucocephalus*)
BAOW = Barred Owl (*Strix varia*)
BEKI = Belted Kingfisher (*Megacerlye alcyon*)
BHCO = Brown-headed Cowbird (*Molothrus ater*)
BLJA = Blue Jay (*Cyanocitta cristata*)
BLVU = Black Vulture (*Coragyps atratus*)
BRCR = Brown Creeper (*Certhia familiaris*)
CACH = Carolina Chickadee (*Parus carolinensis*)
CAGO = Canada Goose (*Branta Canadensis*)
CAWR = Carolina Wren (*Thryothorus ludovicianus*)
COFL = Common Flicker (*Colaptes auratus*)
COGR = Common Grackle (*Quiscalus quiscula*)
COPI = Common Pintail (*Anas acuta*)
DEJU = Dark-eyed Junco (*Junco hyemalis*)
DOWO = Downy Woodpecker (*Picoides pubescens*)
EABL = Eastern Bluebird (*Sialia sialis*)
EAME = Eastern Meadowlark (*Sturnella magna*)
EAPH = Eastern Phoebe (*Sayornis phoebe*)
EATO = Eastern Towhee (*Pipilo erythrophthalmus*)
ETTI = Eastern Tufted Titmouse (*Parus bicolor*)
EUST = European Starling (*Sturnus vulgaris*)
FICR = Fish Crow (*Corvus ossifragus*)
FISP = Field Sparrow (*Spizella pusilla*)
FOSP = Fox Sparrow (*Passerella iliaca*)
GBHE = Great Blue Heron (*Ardea herodias*)
GCKI = Golden-crowned Kinglet (*Regulus satrapa*)

b (continued)
GHOW = Great Horned Owl (*Bubo virginianus*)
HAWO = Hairy Woodpecker (*Picoides villosus*)
HETH = Hermit Thrush (*Catharus guttatus*)
HOFI = House Finch (*Carpodacus mexicanus*)
HOLA = Horned Lark (*Eremophila alpestris*)
HOME = Hooded Merganser (*Lophodytes cucullatus*)
HOWR = House Wren (*Troglodytes aedon*)
KILL = Killdeer (*Charadrius vociferus*)
LISP = Lincoln's Sparrow (*Melospiza lincolnii*)
MALL = Mallard (*Anas platyrhynchos*)
MODO = Mourning Dove (*Zenaida macroura*)
NOCA = Northern Cardinal (*Cardinalis cardinalis*)
NOHA = Northern Harrier (*Circus cyaneus*)
PIWO = Pileated Woodpecker (*Dryocopus pileatus*)
PUFI = Purple Finch (*Carpodacus purpureus*)
RBGU = Ring-billed Gull (*Larus delawarensis*)
RBWO = Red-bellied Woodpecker (*Melanerpes carolinus*)
RCKI = Ruby-crowned Kinglet (*Regulus calendula*)
REDH = Redhead (*Aythya americana*)
RHWO = Red-headed Woodpecker (*Melanerpes erythrocephalus*)
ROGO = Ross' Goose (*Chen rosii*)
RSHA = Red-shouldered Hawk (*Butoe lineatus*)
RTHA = Red-tailed Hawk (*Buteo jamaicensis*)
RUBL = Rusty Blackbird (*Euphagus carolinus*)
RWBL = Red-winged Blackbird (*Agelaius phoeniceus*)
SCOW = Common Screech Owl (*Otus asio*)
SNGO = Snow Goose (*Chen caerulescens*)
SOSP = Song Sparrow (*Melospiza melodia*)
SSHA = Sharp-shinned Hawk (*Accipiter striatus*)
SWSP = Swamp Sparrow (*Melospiza georgiana*)
TUVU = Turkey Vulture (*Cathartes aura*)
WBNU = White-breasted Nuthatch (*Sitta carolinensis*)

b (continued)
WCSP = White-crowned Sparrow (*Zonotrichia leucophrys*)
WFGO = White-fronted Goose (*Anser Albifrons*)
WIWR = Winter Wren (*Troglodytes troglodytes*)
AMWO = American Woodcock (*Philohela minor*)
WODU = Wood Duck (*Aix sponsa*)
WTSP = White-throated Sparrow (*Zonotrichia albicollis*)
YBSA = Yellow-bellied Sapsucker (*Sphyrapicus varius*)
YRWA = Yellow-rumped Warbler (*Dendroica coronata*)

c Number of census points (including replication) located in a particular habitat.

d FO = Species flew over forest during census.

e Number in parentheses indicates the average group size for species that were seen in flocks (groups). When a parenthetical number appears, the abundance value refers to the number of groups per census point (e.g., for MALL in SEWFF there were 0.111 groups/census point with an average group size of 144). All other abundance values refer to number of individuals per point.

f P = Species present within the forest during census, but at distances never < 70 m from census points.

g PF = Species present in field adjacent to the forest.

h Number of species present in that particular forest habitat (not including those listed as FO or PF).