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Avian Communities in Forested Reparian Wetlands of Southern Michigan

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Major professor

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AVIAN COMMUNITIES IN FORESTED RIPARIAN WETLANDS OF SOUTHERN MICHIGAN

By

Rainy Lynn Inman

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ABSTRACT

AVIAN COMMUNITIES IN FORESTED RIPARIAN WETLANDS OF SOUTHERN MICHIGAN

By

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There is a lack of information concerning the avifauna that inhabit midwestern riparian forests relative to riparian management and national wetland inventory objectives. For our study, we selected five undisturbed floodplain sites in the southern Lower Peninsula of Michigan. At each site, 0.64 ha circular sample plots were placed in a stratified random fashion in three forested wetland zones, and within forested upland areas adjacent to the floodplain (7-8 plots per site). Point-count surveys were conducted during the early, mid, and late breeding bird seasons (1998-1999) to assess the relative abundance and diversity of the breeding bird community in relation to the hydrology and woody plant structure and species compostion measured within each plot (391 total point-counts). Trends in ground water depths were similar across forested wetland zones, which were consistently wetter than adjacent uplands. Plant species richness, dominance, and vegetation structure differed between forested wetlands and uplands, but were similar among forested wetland areas. Of the 115 bird species detected, 53 were categorized as breeders within our southern Michigan sites. Breeding bird abundance and richness were greater in the forested wetlands than within adjacent uplands, and 15 species had significantly higher breeding densities within forested wetland zones as compared to the upland. Thus, riparian zones in Michigan are important breeding habitats for an array of avian species not always found in upland sites.

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INTRODUCTION

Wetlands are characterized by the presence of water, soil conditions unlike the adjacent upland, and a tendency to support hydrophytic vegetation (Mitsch and Gosselink 1993). Riparian forested wetlands are areas dominated by trees, where the water table is influenced by the water levels of the adjacent stream or river, and which is slightly below to slightly above the land surface long enough annually to form hydric soils and to support hydrophyte growth (Cowardin et al. 1979).

Overbank silt deposition and fluctuating forest hydrology are two important physical characteristics which distinguish forested floodplain wetlands from hardwood swamps not adjacent to river valleys (Curtis 1959, Brower et al. 1990). However, forested floodplain wetlands exhibit several other unusual attributes including: a linear form due to their proximity to the river; a higher flux of energy and materials than any other wetland type due to the open system; and their functional connection to upstream and downstream ecosystems and lateral connection to upslope (upland) and downslope (aquatic) ecosystems (Brinson et al. 1981). These floodplain ecosystems are generally considered to have higher production rates than surrounding uplands and many other wetlands because of the periodic inflow of nutrients transported by seasonal flooding (Mitsch and Gosselink 1993). Johnson and McCormick (1979) stated that these ecosystems are uniquely characterized by high levels of plant diversity, density, and productivity.

The unique hydrologic and nutrient conditions within floodplain sites often influence the establishment and succession of plant species (Van der Valk 1982). Factors such as rate of flow, seasonality of flooding, and duration of flooding determine the

ecology and chemistry of the floodplain, creating a community of herbaceous and woody species adapted to the riparian conditions (Conner and Day 1982). Curtis (1959) explained this distinct floodplain community as a result of spatial and temporal variation that leads to unique spatial distributions of component species. He also stated that within the floodplain habitat, variation in the plant community was typically associated with gradients in available moisture, temperature, and light. Curtis (1959) found that the most straightforward correlation to the species distribution was the gradation of water-retaining capacities of the soil. His conclusions were later supported by several studies which correlated the moisture gradient of the floodplain to vegetative species distribution and diversity (Hosner and Minckler 1963, Johnson and Bell 1976, Franz and Bazzaz 1977, Robertson et al. 1984, Smith 1996).

Recent efforts to inventory our national wetlands indicate that a significant proportion of forested floodplain wetlands within the United States have been lost over the last century (Brinson et al. 1981, Abernethy and Turner 1987, Dahl 1990). A variety of influences are responsible for the reduction of forested wetlands, including agricultural and industrial development, logging, and abusive recreation (Shear et al. 1996, Dowd 1992). As these wetlands are damaged or destroyed, critical habitat conducive to high wildlife diversity and abundance are lost or diminished (Bull and Skovlin 1982, Sanders and Edge 1998, Whitaker and Montevecchi 1999). Thomas (1979) stated that wildlife generally use riparian zones more than any other habitat type, because these wetlands provide all three essential habitat components: food, cover, and water. Brinson et al. (1981) expanded this concept to define four ecological attributes that are important to the wildlife of riparian ecosystems:

1. The predominance of woody plant communities provides protection, roosting and nesting areas, favorable microclimates, and standing dead trees and snags that are valuable habitat for both aquatic and terrestrial animals.
2. The presence of surface water and plentiful soil moisture provide important food resources for consumers, an area of protection and travel, and breeding grounds for amphibians and fish.
3. The diversity and interspersion of habitat features provide numerous niches for an abundance of wildlife species.
4. The linear nature of the floodplain provides protective corridors for dispersal and migration for birds, ungulates, small mammals, and fish (within the river).

To aid in management and mitigation, recent attempts have been made to develop evaluation methods for assessing the wildlife habitat functions of these forested wetlands (Adamus et al. 1990). However, the scarcity of literature on wildlife use within these systems has hampered the development of assessment techniques (Wakeley and Roberts 1996).

Several researchers in the northwest and southeast U.S. have undertaken studies which focus on the avian component within forested wetland habitats. Bull and Skovlin (1982) correlated bird species abundance and diversity to varying densities of streamside vegetative cover (low, moderate, and high), and discovered that species diversity and abundance was greatest in the moderate cover class. It has also been documented that avian-habitat associations in riparian areas are primarily influenced by the vegetative composition and structure, which are determined by the soil moisture gradient of the floodplain (Smith 1977, Douglas et al. 1992). Furthermore, it has been reported that

species abundance and overall bird species richness differ significantly across vegetative cover types (Wakeley and Roberts 1996, Sanders and Edge 1998). However, few studies have concentrated on the forested floodplains of the Midwest region (Adams et al. 1995). The lack of research in this region combined with the probable values they possess in terms of wildlife and social benefits, make these ecosystems a primary focus for ecological study. Thus, the purpose of this project was to characterize the forested wetland zone of river floodplains in southern Michigan.

The project focused on the composition and structure of the woody plant species and the associated avian community within forested floodplains. I hypothesized that the climatic and moisture conditions of the forested wetland would support a woody plant community structurally different from the surrounding upland habitats. I further hypothesized that the forested wetlands would support a distinctive bird community. Specifically, the avian species relative abundance and richness would be different within the forested wetlands than within adjacent upland areas. It was also probable that the density of individual bird species and the combination of bird species within these forested floodplain habitats would be unique to the wetland ecosystem, as compared to the upland. Deciduous forested floodplains were chosen for study because the decline of lowland forests has been greatest in the southern lower peninsula, due to increased human population and development pressures. Thus, the need for management was greatest in this area.

METHODS

Study Area

Research was conducted in forested floodplains adjacent to several southern Lower Michigan river systems (Figure 1). In this region the growing season averages 200-240 days, and the climate is temperate and humid (Austin 1979, Barnes et al. 1979, Feenstra 1979, Knapp 1987). Although optimum "reference sites" would be historically undisturbed by human use, few or no such areas exist in the populated region of southern Michigan. Most forested floodplain habitats have been altered from their primary forested state through stream modifications, agricultural use, or lumbering. The riparian forests judged to be least impacted by human perturbations were thus used as reference sites for this project.

Riparian stands selected were at least 10 ha in size, and at least 30 years of age. Sites were adjacent to reaches of rivers with natural flow regimes (upstream of any impoundment). All study sites were located within or south of the theoretical transition, or tension, zone (Figure 1). This zone is a region of 47 degree Fahrenheit isotherm of mean annual temperature which divides Michigan's lower peninsula into northern and southern vegetative habitats (Barnes and Wagner 1981). In this area of Michigan, the majority of lowland forests were expected to be dominated by deciduous trees (Albert 1995).

Sites were also chosen to incorporate a regional sampling distribution across southern Michigan (Figure 1). In 1998, four study sites were identified, including Maple River State Game Area-2 sites (Maple River; T. 8N., R. 5W., Ionia County and T. 8N., R. 4W., Clinton County), Allegan State Game Area-1 site (Kalamazoo River; T. 3N./2N., R. 14W., Allegan County), and Red Cedar Riverwalk Crego Park-1 site (Red Cedar River; T. 4N., R. 12W., Ingham County). An additional site, the Augusta Floodplain Reserve (Kalamazoo River; T. 2S., R. 9W., Kalamazoo County), was added in 1999.

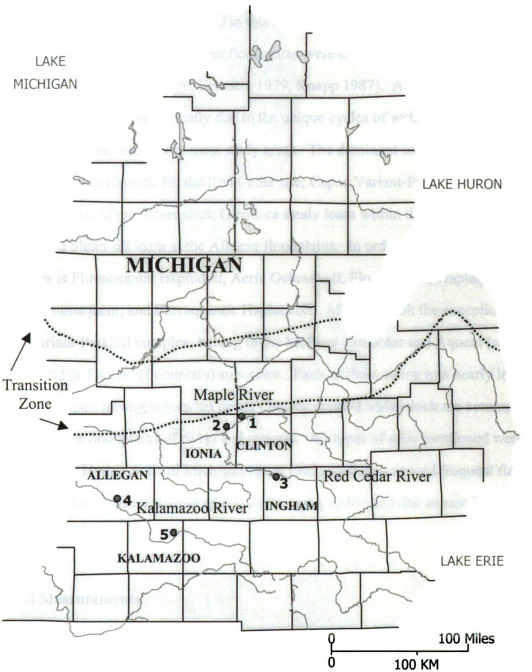

Figure 1. Location of southern Michigan study sites (1-Maple River 1, 2-Maple River 2, 3-Red Cedar, 4-Allegan, 5-Augusta).

Reference floodplains were generally lacking in the southeast corner of the state, and therefore, no sampling was conducted in this area.

Soils data for each of the river floodplains were obtained from county soils books (Austin 1979, Barnes et al. 1979, Feenstra 1979, Knapp 1987). Although regional floodplain soils tend to vary greatly due to the unique cycles of wetting and drying, some characteristics were common to most study areas. The dominant soil series for each reference area was Ceresco for the Red Cedar site; Capac Variant-Parkhill complex and Sloan loam at the Maple River sites; Glendora sandy loam within the Augusta Floodplain Reserve; and Sloan silt loam at the Allegan floodplains. In order, the taxonomic class for each series is Fluvaquentic Hapludoll, Aeric Ochraqualf, Fluvaquentic Haplaquoll, Mollic Psammaquent, and Fluvaquentic Haplaquoll. All soils, with the exception of the Capac Variant-Parkhill complex, belong to the Mollisol soil order and Aquent (wet entisols) and/or Fluvent (floodplain) suborders. Each of these series was nearly level with 0-2% slopes, having somewhat or very poorly drained soils which are commonly found along the floodplains of rivers and streams. All types of soils mentioned were included in the Hydric Soils of Michigan (SCS 1993), and experienced frequent flooding (exception of the Capac Variant-Parkhill series, not a hydric soil due to rare flooding regimes).

Habitat Measurements

At each site, plots were placed in a stratified random fashion in each of four survey zones: I-Forested Wetland, II-Forested Wetland, III-Forested Wetland, IV-Upland (Figure 2). Forested wetland survey zones were placed in the river floodplain, and initially defined by proximity to the river. Survey zone I was set directly on the river bank, survey zone II was set 100-200 m from the river bank, and survey zone III was set 300-400 m from the river bank. The upland survey zone was placed within upland habitat directly adjacent to the floodplain areas. Plots were established prior to the

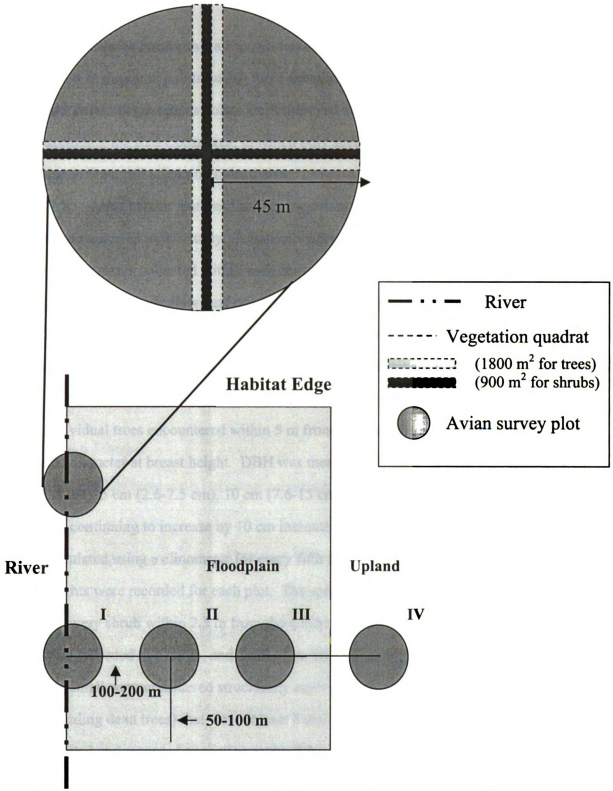

Figure 2. Sampling protocol used for placement of 0.64 ha (45 m radius) avian survey plots and vegetation quadrats (1800 m^2 for trees and 900 m^2 for shrubs) within study sites.

field season to ensure that all four zones could be sampled, and to enable researchers to return to the same points during three sampling periods of the bird breeding season over two years. Eight census points were surveyed at each site (two plots in each survey zone) excluding the Red Cedar area, in which only seven plots were used (only one upland plot) due to the small adjoining upland area.

Most habitat features listed as important to bird species in Bibby et al. (1992) were measured in this study. Avian habitats were analyzed using vegetative measurements collected within each census plot using two quadrats: one approximately parallel to the river flow, and one approximately perpendicular to the river flow (Figure 2). Vegetation quadrats ran the full 90 m diameter of the census plot. The following measures were taken on each census plot only once during the 1998 field season for the original four study sites, and during the 1999 season for the additional study site. Individual trees encountered within 5 m from quadrat center were recorded by species and diameter at breast height. DBH was measured in the following size classes: 1 cm (1-2.5 cm), 5 cm (2.6-7.5 cm), 10 cm (7.6-15 cm), 20 cm (15.1-25 cm), 30 cm (25.1-35 cm), and continuing to increase by 10 cm increments (Curtis 1959). Tree heights were calculated using a clinometer for every fifth tree within the sampled area until twenty tree heights were recorded for each plot. The species, stem number, and height were recorded for every shrub within 2.5 m from the quadrat center. Trees with a dbh less than 1 cm were recorded as a shrub, and shrubs less than 50 cm high were not counted, as shrubs this small were considered structurally equivalent to herbaceous groundcover. Snags (standing dead trees) that were at least 5 cm dbh and within the 5 m sample distance were counted and recorded according to the dbh classes. As it was not feasible to measure the dbh of downed woody material, all logs discovered within 5 m of the quadrat center were classified by the widest diameter of the log using 10 cm diameter size classes ("log-width"). All snags and logs recorded were identified to species when this was possible, and were marked as "unknown" otherwise. At all four sites, vertical vegetation density

measurements were taken every third meter along plot transects during the early and the late bird survey periods in 1998. In 1999 these measurements were taken only once for the new site, as cover densities increased only slightly from the 1998 early period (34%) to late period (41%). Vertical density was measured by estimating the percent cover (to the nearest 5%) of the vegetation directly over a meter tape extended the length of the plot transects in four vertical layers: 1) 0-50 cm, 2) 51 cm-3 m, 3) 3.1-5 m, 4) >5 m. These layers were defined to include groundcover, shrubs, understory trees, and overstory canopy.

In the 1999 season, the depth of standing water or depth to the groundwater table was recorded to the nearest 1 cm at the plot center during each bird survey. The groundwater depth was determined using a hand soil auger down to a depth of 95 cm. Groundwater tables deeper than 95 cm were recorded as >95 cm.

Avian Surveys

Birds were surveyed using a modification of the variable circular-plot method proposed by Reynolds et al. (1980). Variable circular-plots were chosen because they are well designed for sampling in structurally complex vegetation, and are often preferred over transects in fine-grained habitats if an objective of the study is to identify habitat determinants of the inhabiting bird community (Bibby et al. 1992, Reynolds et al. 1980). Also, a well-spaced series of point counts represented the area of study better than a few transects; allowed for less distraction within woodlands than trying to avoid obstacles along transects; and had the advantage of greater detection of difficult or secretive birds (Bibby et al. 1992). These point counts were also used to obtain a measure of relative abundance of the birds, and to calculate relative densities of species using a standard sampling area for all individuals recorded (Bibby et al. 1992, Reynolds et al. 1980). This

census technique was ultimately chosen as a result of trial comparisons of several survey methods prior to the actual study, and from a review of the literature recommendations mentioned above.

It is important to note the assumptions related to the circular-plot method. Bibby et al. (1992) provides an adequate summary:

1. Birds do not approach or flee the observer-this may affect density estimates.
2. Birds are 100% detectable by the observer-the density of foliage may bias observations.
3. Birds do not move much during the recording period-may increase the number of double counts on an individual, overestimation of mobile species.
4. Birds behave independently of one another-behavior may affect individuals locations and/or detectability.
5. Violations of the above assumptions are not interactions with the habitat or study design elements-bias may change in different circumstances.
6. Distance estimates to birds are accurate-this may affect density estimates.
7. Birds are fully and correctly identified-this relates to observer bias.

Bird population data were collected on plots having a 45 m fixed-radius (0.64 ha). Circular bands of 25 m, 35 m, and 45 m were used as quality assurance measures for distance estimates of recorded individuals. Plot centers were located at least 50 m from all adjacent vegetation borders and man-made edges (i.e. roads) to avoid sampling species outside of the plot habitat. To reduce the possibility of multiple recordings of an individual bird, plot centers were at least 100 m, but preferably 200 m, from the nearest neighboring plot (Bibby et al. 1992).

Surveys were conducted between sunrise and 10:00 A.M. during the breeding bird season, beginning the second week of May and continuing through the first week of July (Brewer et al. 1991). Fourteen days of data collection were followed by a week in which no sampling occurred to separate the breeding season into three distinct periods: early, mid, and late. Each of the original four study areas were visited twice during the early, mid, and late periods of the breeding season in 1998 and 1999; with an additional site visited similarly in 1999 (Table 1). Each census consisted of a ten minute sampling

Table 1. Number of avian survey plots sampled in forested wetlands and adjacent forested uplands at each study site during the 1998 and 1999 breeding bird seasons.

		Period						
Study Site	**Survey Zone**	**Early**		**Mid**		**Late**		**Total Plots**
		1998	1999	1998	1999	1998	1999	
Allegan	I-Forested Wetland	4	4	4	4	4	4	24
	II-Forested Wetland	4	4	4	4	4	4	24
	III-Forested Wetland	4	2	4	2	4	2	18
	IV-Upland	4	4	4	4	4	4	24
Augusta	I-Forested Wetland	---	2	---	4	---	4	10
	II-Forested Wetland	---	2	---	4	---	4	10
	III-Forested Wetland	---	2	---	4	---	4	10
	IV-Upland	---	2	---	4	---	4	10
Maple 1	I-Forested Wetland	4	4	4	4	4	4	24
	II-Forested Wetland	4	4	4	4	4	4	24
	III-Forested Wetland	4	4	4	4	4	4	24
	IV-Upland	4	4	4	4	4	4	24
Maple 2	I-Forested Wetland	4	4	2	4	4	4	22
	II-Forested Wetland	4	4	2	4	4	4	22
	III-Forested Wetland	4	4	2	4	4	4	22
	IV-Upland	4	4	2	4	4	4	22
Red Cedar	I-Forested Wetland	4	4	4	2	4	4	22
	II-Forested Wetland	4	4	4	2	4	4	22
	III-Forested Wetland	4	4	4	2	4	4	22
	IV-Upland	2	2	2	1	2	2	11
	Total	**46**		**38**		**46**		**391**

period following a three minute settling period initiated upon reaching the center point. During this short time researchers waited for disturbed bird activity to normalize within the plot. All birds heard and/or seen during the sampling period were recorded at their approximate distance from plot center within the distance estimation bands (0-25 m, 25.1-35 m, 35.1-45 m). This included birds whose flight originated or terminated within the plot boundaries (Whitt 1995). Species that were seen or heard within the survey habitat, but did not land within the plot boundary, were noted as either flying over plot or outside of 45 m if their flight path never entered the plot. Birds were recorded as individuals, pairs assumed mated), or family groups. Only adults were counted, although young and nests were noted on the data sheets. No sampling was done during high wind or rain.

Analysis

Water depths recorded in 1999 were averaged by survey plot for each survey zone for the early, mid, and late breeding bird seasons. An analysis of variance (ANOVA, general linear model) was performed, and Pearson correlation coefficients were calculated to compare depths across all four survey zones and also to compare depth differences between the forested wetland zones.

Tree and shrub densities were calculated for each vegetation quadrat (1800 m^2 for trees; 900 m^2 for shrubs), and then averaged across all study sites for each survey zone. Densities were then converted into trees per hectare and shrubs per hectare. Mean tree diameter at breast height (dbh) was also calculated for each vegetation quadrat, and

similarly averaged for each survey zone. Mean basal area was calculated by adding the basal area of individual trees within vegetation quadrats, and averaging across quadrats for each survey zone. Vegetation richness was calculated for trees and shrubs by summing all species recorded at study site in each survey zone. Tree and shrub species richness values were also summed over all study sites for each survey zone. Importance values were calculated for each tree species recorded within the 1800 m^2 vegetation quadrats, and for each shrub species recorded within the 900 m^2 vegetation quadrats. Tree importance values were based on the sum of the relative frequency, relative density, and relative dominance (percent basal cover). Shrub importance values were based on the sum of the relative frequency and relative density (Curtis 1959, Cain and Castro 1959). Importance values (maximum value = 300 for trees and =200 for shrubs) were averaged for each survey zone.

Vertical vegetation density was calculated by averaging percent cover values by survey plot for each survey zone. This calculation was completed for each of the four vertical layers of growth.

Snags and logs observed within the 1800 m^2 vegetation quadrats were summarized by total number recorded in each dbh or log-width size class for each survey zone. Total (all size classes) snag and log densities were calculated for each vegetation quadrat and averaged across all study sites for each survey zone.

Avian densities were calculated on a survey plot basis for each species. Density was computed by dividing the within plot count (excludes birds observed flying over or outside of plot) of a given species by 0.64 ha to the density per hectare. These density values were then averaged across all study sites for each survey zone for every bird

species. Avian richness was calculated for breeding species and for migrating/transient species. The total number of species in each category was summed for each study site within each survey zone, and across all study sites for each survey zone. Mean number of species per plot was calculated by averaging individual plot species counts across all study sites for each survey zone.

Vegetation and avian density values, mean dbh values, mean basal area values, and mean avian plot richness values were compared by study site, survey zone, and the associated interaction using Statistical Analysis Software (SAS v.6.12, SAS 1990). An analysis of variance (ANOVA) was performed using the general linear model (GLM) and mixed procedures. Least-square means statements were utilized to estimate density and other mean values, as well as related standard errors (SAS 1990). Orthogonal contrasts were used to compare least-square means calculated by mixed procedures (avian densities), in order to incorporate the unbalanced data (not all species were observed at all plots). Differences were considered significant if a p-value < 0.05 was demonstrated.

RESULTS

Water Depth

Mean water depth trends in 1999 were similar for all forested wetland areas. Standing water occurred in only one zone and only during the early census period. Otherwise, water levels were below the soil surface throughout the census periods. Forested wetlands had higher mean water depths than upland zone in all periods. Mean water depth in the upland decreased from the early to the late breeding period, having many individual depth records below –95 cm (the limit of our measurements). Water depth was highly correlated with survey zone when all four zones were compared ($r = -0.259$, $P=0.0002$). Differences in depth between season periods ($F=20.81$, $P=0.0001$), survey zones ($F=31.61$, $P=0.0001$), and survey zones within periods ($F=3.36$, $P=0.0036$) were all highly significant (Figure 3). Within forested wetlands differences in depth were significant for period ($F=20.05$, $P=0.0001$) and survey zone ($F=13.61$, $P=0.0001$), but not for survey zone within period ($F=1.87$, $P=0.1193$).

Vegetation Structure and Composition

Mean shrub density (shrubs ha^{-1}) differed significantly between survey zones ($F=10.67$, $P=0.0006$), but shrub density patterns among zones were similar between sites (General Linear Model, $F=1.09$, $P=0.4004$; zone x site interaction, $F=1.31$, $P=0.3110$) (Table 2). Shrub density in the forested wetlands was similar, but was significantly higher in upland zone IV. Mean tree density (trees ha^{-1}) differed significantly between sites (General Linear Model, $F=19.62$, $P=0.0001$) and between survey zones ($F=4.95$, $P=0.0066$) (Table 2). The interaction of site and survey zone was also significant

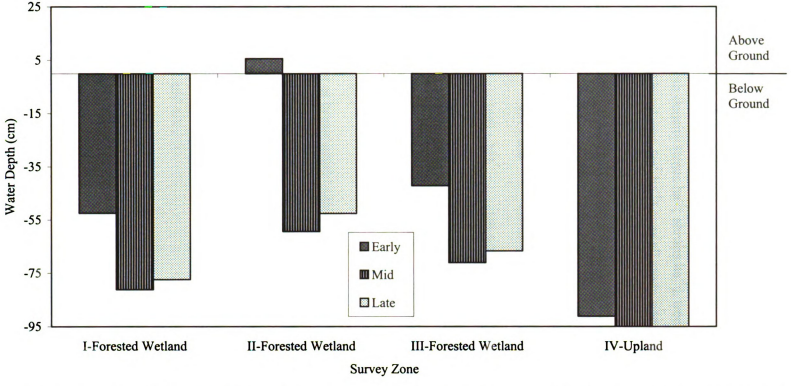

Figure 3. Mean water level in forested wetland and adjacent upland plots across all study sites during the 1999 early, mid, and late breeding bird season. Groundwater depths below –95 cm were not measured.

(F=5.27, P=0.0007). Tree densities increased from the river (zone I) toward the upland (zone IV). Densities were again similar for forested wetland zones, and significantly greater in the adjacent upland.

Table 2. Tree and shrub density (trees ha^{-1}; shrubs ha^{-1}), tree diameter at breast height (dbh), and total basal area (m^2 ha^{-1}) over all study sites for each forested wetland and nearby upland survey zones in southern Michigan.

	Survey Zone			
	I-Forested Wetland	**II-Forested Wetland**	**III-Forested Wetland**	**IV-Upland**
Shrub Density (x ± SE)	954 ± 656	1504 ± 757	892 ± 656	5370 ± 656
Tree Density (x ± SE)	1039 ± 222	1139 ± 222	1543 ± 222	3103 ± 243
DBH (cm) (x ± SE)	20.5 ± 0.4	23.3 ± 0.4	17.0 ± 0.3	6.6 ± 0.3
Basal Area (x ± SE)	70.4 ± 11.3	61.6 ± 1.4	54.1 ± 7.0	32.8 ± 10.9

Mean diameter at breast height (dbh) was similar for trees in the forested wetlands, and significantly higher as compared to the upland zone (Table 2). Mean dbh values ranged from a high of 23.3 ± 0.4 cm in forested wetland zone II, to a low of 6.6 ± 0.3 cm in the upland zone. Differences between survey zones (General Linear Model, F=641.28, P=0.0001) and sites (F=106.12, P=0.0001) were considered highly significant, as was the difference between survey zones at particular study areas (zone x site interaction, F=82.13, P=0.0001).

Mean basal area (m^2 ha^{-1}) for trees also decreased from the river toward the upland, having the highest basal area near the river and the lowest basal area in the upland areas (Table 2). The only significant differences occurred between the upland and

the forested wetland, as the basal areas of forested wetland areas II and III were similar to forested wetland I.

Patterns of vertical vegetation cover across the forested wetland were characterized by moderate groundcover, sparse shrub and sapling cover, and a well developed canopy layer (Table 3). Forested wetland zone II had the least amount of cover

Table 3. Vegetation cover (% ± SE) in four vertical layers of growth for forested wetland and upland survey zones across southern Michigan study sites.

	Percent Cover (% ± SE)			
Vertical Layer	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Groundcover (0 cm-50 cm)	60 ± 6	46 ± 6	57 ± 6	34 ± 6
Shrubs (51 cm-3 m)	27 ± 4	14 ± 4	28 ± 4	38 ± 5
Saplings (3 m-5 m)	22 ± 4	11 ± 4	20 ± 4	30 ± 4
Canopy (+5 m)	73 ± 5	74 ± 5	75 ± 5	55 ± 6

in the ground, shrub, and sapling layers. Canopy closure in the forested wetlands was approximately 74%. Compared with the wetland areas, the upland zone supported relatively less groundcover, had denser shrub and sapling growth, and a less developed canopy. Within each vegetation layer, the survey zone had a significant effect on percent cover values (Mixed Procedure, F=4.46, P=0.0102 for groundcover; F=4.60, P=0.0090 for shrubs; F=5.02, P=0.0060 for saplings; F=3.17, P=0.0378 for canopy), although cover

values did not always different between individual zones.

Forested upland zones consistently supported the greatest number of tree and shrub species within and across study sites, with the exception of one site (Maple 1), compared to the forested wetlands (Table 4). At the Maple 1 site, low numbers of tree and shrub species in the upland zone were likely a result of past cutting to clear the area for agricultural cultivation. There was also a low number of shrub species in the Red

Table 4. Species richness summed over each survey zone for trees and shrubs at each study site in forested wetland and adjacent upland survey zones.

	Species Richness			
Study Sites	**I-Forested Wetland**	**II-Forested Wetland**	**III-Forested Wetland**	**IV-Upland**
Trees				
Allegan	14	5	11	22
Augusta	13	12	13	17
Maple 1	10	6	9	4
Maple 2	9	6	8	26
Red Cedar	12	9	6	17
All Sites	**26**	**22**	**25**	**36**
Shrubs				
Allegan	12	2	6	20
Augusta	4	12	8	16
Maple 1	6	3	3	5
Maple 2	3	5	4	30
Red Cedar	6	5	6	8
All Sites	**17**	**15**	**16**	**43**

Cedar upland zone where only one plot was sampled, as compared to two plot at other study areas. A total of 47 tree and 49 shrub species were observed across all sites in riverine forests and adjacent upland areas (Appendix A, B).

Two tree species, silver maple (*Acer saccharinum*) and green ash (*Fraxinus pennsylvanica*), dominated all three forested wetland zones, and were the only dominant trees in forested wetland I with an importance value greater than 30 (max=300) (Table 5, Appendix C). American elm (*Ulmus americana*) was the third and final dominant in forested wetland II and III. The riverine forests shared no dominant trees with the upland zone, where sugar maple (*Acer saccharum*) and red oak (*Quercus rubra*) had the highest importance values. Spice bush (*Lindera benzoin*) and green ash dominated forested wetland zones (IV>20). Common buttonbush (*Cephalanthus occidentalis*) was a co-dominant in forested wetlands I and II, with the addition of highbush-cranberry (*Viburnum opulus*) in forested wetland I. Gray dogwood (*Cornus foemina*) and sugar maple seedlings were the only dominant shrub species for the upland zone.

The riverine forest zones were designated forested wetlands based on the dominant wetland vegetation being classified as either FACW or OBL and secondary wetland indicators, in accordance with the United States Army Corps methods of wetland delineation (Environmental Laboratory 1987). In contrast, the upland zone dominants were all facultative upland species, and no secondary wetland indicators were found.

Snags and Logs

Mean number of snags per hectare did not significantly differ between survey zones (Mixed Procedure, F=1.60, P=0.2099) (Figure 4). All three forested wetland zones

Table 5. Importance values of tree and shrub species sampled within 39 vegetation quadrats (1800 m^2 for trees; 900 m^2 for shrubs) positioned within forested wetland and adjacent upland survey plots.

Species[a]	Indicator[c]	Importance Value (IV)[b] I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Trees					
Silver Maple	FACW	104	98	70	8
Green Ash	FACW	46	75	91	5
American Elm	FACW-	23	32	30	9
Sugar Maple	FACU	0	2	3	35
Red Oak	FACU	1	0	0	32
Shrubs					
Spice Bush	FACW-	54	55	88	7
Green Ash	FACW	21	59	26	5
Common Buttonbush	OBL	22	33	16	2
Highbush-cranberry	FACW	20	8	3	4
Sugar Maple	FACU	0	0	0	23
Gray Dogwood	FAC	0	4	4	20

[a]Species with importance values over 30 for trees, and over 20 for shrubs, in any survey zone are listed. Complete plant species lists can be referenced in Appendix A and B.

[b]Maximum importance value = 300 for trees; 200 for shrubs.

[c]Indicators:

FACU=Facultative Upland; usually occurs in non-wetlands (1%-33% probability in wetlands)
FAC= Facultative; equally likely to occur in wetlands or non-wetlands (34%-66% probability)
FACW=Facultative Wetland; usually occurs in wetlands (67%-99% probability in wetlands)
OBL=Obligate; almost always occurs in wetlands under natural conditions (>99% probability)
+ Indicates wetter conditions
- Indicates drier conditions

had a greater proportion of larger size snags than did the upland. Differences between survey zones were significant for the mean number of logs per hectare (Mixed Procedure, F=6.78, P=0.0013). Total numbers of logs was highest in floodplain zones II and III (Appendix D).

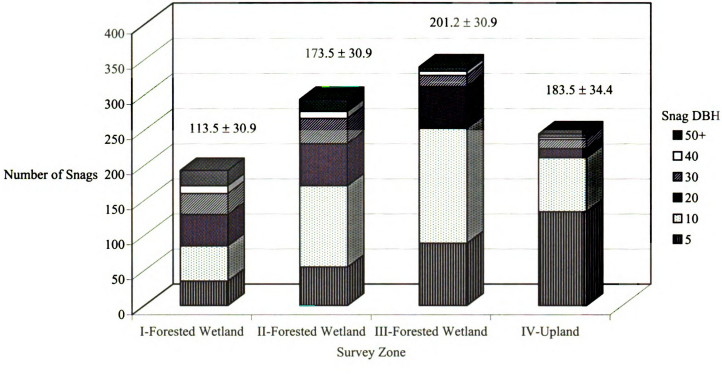

Figure 4. Number of snags observed in vegetation quadrats (1800 m^2) in each diameter at breast height (dbh) size class (cm). Snags were summed over all southern Michigan study sites for each forested wetland and upland zone.

Breeding Bird Surveys

A total of 10,664 individuals representing 115 bird species were observed within survey plots, flying through plots, or just outside of survey plots during the 1998 and 1999 breeding seasons (Appendix E, F). Those species recorded within survey plots (85 species) were identified as either breeding or migrating/transient based on breeding bird criteria of Brown and Dinsmore (1986) and habitat requirements presented by Brewer et al. (1991) (Table 6). Species were listed as breeders if the breeding criteria and habitat

Table 6. Avian species observed within forested wetland and upland zones over all study sites (within plot observations only) during the 1998 and 1999 breeding seasons. Each species historical status as a breeder or migrant in southern lower Michigan, as well as their breeding status in each survey zone of this study, is listed. Species are listed as a breeder if there was confirmed evidence of breeding in at least one survey survey zone.

		Survey Zones			
Common Name	**Southern MI Breeding Status[a]**	**I-Forested Wetland**	**II-Forested Wetland**	**III-Forested Wetland**	**IV-Upland**
Breeder					
Acadian Flycatcher	UB	B	B	B	B
American Crow	B	B	B	B	B
American Goldfinch	B	T	T	T	B
American Redstart	B	B	B	B	B
American Robin	B	B	B	B	B
American Woodcock	B	.	.	.	B
Belted Kingfisher	B	B	B	B	.
Black-capped Chickadee	B	B	B	B	B
Blue-gray Gnatcatcher	B	B	B	B	B
Blue-winged Warbler	B	.	.	.	B
Blue Jay	B	B	B	B	B
Brown-headed Cowbird	B	B	B	B	B
Brown Creeper	B	B	B	B	B
Canada Goose	B	B	B	.	T
Cerulean Warbler	UB	B	B	B	B
Common Grackle	B	B	B	B	B
Common Yellowthroat	B	T	T	T	B
Downy Woodpecker	B	B	B	B	B
Eastern Phoebe	B	B	B	.	B

Table 6 (cont'd).

Common Name	Southern MI Breeding Status[a]	Survey Zones I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Breeder					
Eastern Wood-Pewee	B	B	B	B	B
Gray Catbird	B	B	B	B	B
Great Crested Flycatcher	B	B	B	B	B
Hairy Woodpecker	B	B	B	B	B
Hooded Merganser	B	B	.	.	.
Indigo Bunting	B	B	B	B	B
Least Flycatcher	B	B	B	B	.
Mallard	B	B	.	.	.
Northern Cardinal	B	B	B	B	B
Northern Flicker	B	B	B	B	B
Northern Oriole	B	B	B	B	B
Northern Rough-winged Swallow	B	B	.	.	.
Ovenbird	B	T	.	.	B
Prothonotary Warbler	UB	B	B	B	.
Red-bellied Woodpecker	B	B	B	B	B
Red-eyed Vireo	B	B	B	B	B
Red-headed Woodpecker	B	B	B	.	.
Red-tailed Hawk	B	.	B	B	.
Red-winged Blackbird	B	B	B	B	B
Rose-breasted Grosbeak	B	B	B	B	B
Ruby-throated Hummingbird	B	B	B	B	B
Scarlet Tanager	B	B	B	B	B
Song Sparrow	B	B	B	B	B
Tree Swallow	B	B	B	.	.
Tufted Titmouse	B	B	B	B	B
Veery	B	.	B	B	B
Warbling Vireo	B	B	B	B	.
White-breasted Nuthatch	B	B	B	B	B
Willow Flycatcher	B	.	.	.	B
Wood Duck	B	B	B	B	.
Wood Thrush	B	B	B	B	B
Yellow-billed Cuckoo	B	T	T	T	B
Yellow-throated Vireo	B	B	B	B	B
Yellow Warbler	B	B	B	B	B
Migrant/Transient					
Alder Flycatcher	UB	.	.	.	T
Barn Swallow	B	T	T	.	.
Bay-breasted Warbler	B	.	T	.	.
Black-and-white Warbler	UB	T	.	T	.
Black-billed Cuckoo	B	.	.	.	T

Table 6 (cont'd).

Common Name	Southern MI Breeding Status[a]	Survey Zones I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Migrant/Transient					
Black-throated Green Warbler	M	M	.	M	M
Black-throated Blue Warbler	M	.	.	.	M
Blackburnian Warbler	M	.	.	M	M
Brown Thrasher	B	.	.	.	T
Carolina Wren	UB	T	.	T	.
Cedar Waxwing	B	T	T	T	T
Cooper's Hawk	B	.	.	.	T
European Starling	B	.	T	T	.
Field Sparrow	B	.	.	.	T
Golden-winged Warbler	B	T	.	.	.
Great Blue Heron	B	T	T	.	.
House Sparrow	B	.	.	T	.
House Wren	B	.	.	.	T
Magnolia Warbler	B	T	T	.	T
Mourning Dove	B	T	.	.	T
Mourning Warbler	M,UB	M	.	M	.
Nashville Warbler	M	M	M	M	M
Northern Parula Warbler	M	M	.	.	.
Northern Waterthrush	M	.	M	.	M
Orange-crowned Warbler	M	.	.	.	M
Savannah Sparrow	B	.	.	.	T
Solitary Vireo	B	.	T	.	.
Spotted Sandpiper	B	T	.	.	.
Swainson's Thrush	M	M	.	.	.
Tennessee Warbler	M	M	M	M	M
Wild Turkey	B	T	.	.	.
Yellow-rumped Warbler	B	T	T	T	T

[a]Breeding Status Abbreviations:
B=Confirmed evidence of breeding UB=Unconfirmed, but suspected breeding
M=Regional migrant
T=Regional breeder (confirmed or unconfirmed) , but transient through survey zone
.=Not observed within plot in the survey zone

requirements were met for a given species in at least one survey zone. Of the 85 avian species found within plots in the forested wetland and upland zones, 53 were considered actively breeding, and 32 were considered migrants/transients. Although the majority of breeding species were observed in forested wetlands and nearby uplands (34 species), 12

species were found breeding only in the forested wetlands, while 7 species bred solely in the upland (Table 7).

Table 7. Avian species observed breeding within the forested wetland and upland zones versus species breeding exclusively in the forested wetland zones or the upland zone. Species listed include those observed within survey plots during the 1998 and 1999 breeding bird seasons in the southern Michigan study areas.

Avian Species		
Forested Wetland & Upland	**Forested Wetland**	**Upland**
Ruby-throated Hummingbird	Canada Goose	American Woodcock
Red-bellied Woodpecker	Wood Duck	Yellow-billed Cuckoo
Downy Woodpecker	Mallard	Willow Flycatcher
Hairy Woodpecker	Hooded Merganser	Blue-winged Warbler
Northern Flicker	Red-Tailed Hawk	Ovenbird
Eastern Wood-Pewee	Belted Kingfisher	Common Yellowthroat
Acadian Flycatcher	Red-headed Woodpecker	American Goldfinch
Eastern Phoebe	Least Flycatcher	
Great Crested Flycatcher	Tree Swallow	
Blue Jay	Northern Rough-winged Swallow	
American Crow	Warbling Vireo	
Black-capped Chickadee	Prothonotary Warbler	
Tufted Titmouse		
White-breasted Nuthatch		
Brown Creeper		
Blue-Gray Gnatcatcher		
Veery		
Wood Thrush		
American Robin		
Gray Catbird		
Yellow-throated Vireo		
Red-eyed Vireo		
Yellow Warbler		
Cerulean Warbler		
American Redstart		
Scarlet Tanager		
Northern Cardinal		
Rose-breasted Grosbeak		
Indigo Bunting		
Song Sparrow		
Red-winged Blackbird		
Common Grackle		
Brown-headed Cowbird		
Northern Oriole		

Avian richness was divided into breeding and migrating/transient categories for survey zones within and across study sites (Table 8). All sites had the highest number of

Table 8. Total avian richness of breeders and migrants/transients (within plot observations only) and mean avian richness (species/0.64 ha plot) in forested wetland and adjacent upland survey zones across southern Michigan study areas.

		Avian Richness (Breeders : Migrants/Transients)			
River	Study Site	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Kalamazoo	Allegan	29 : 7	29 : 4	28 : 6	22 : 3
Kalamazoo	Augusta	25 : 4	23 : 2	21 : 1	22 : 3
Maple	Maple 1	30 : 7	27 : 3	28 : 5	21 : 5
Maple	Maple 2	28 : 8	22 : 6	27 : 4	28 : 10
Red Cedar	Red Cedar	30 : 9	27 : 6	27 : 8	18 : 3
	Total	**44 : 21**	**43 : 14**	**39 : 14**	**41 : 19**
Species/Plot (x ± SE)		**7.2 ± 0.3**	**5.8 ± 0.3**	**6.2 ± 0.3**	**5.4 ± 0.3**

breeding species near the river in forested wetland I. However, breeder richness was similar across forested wetlands and uplands. Migrants/transients species counts tended to be highest near the river and decrease toward the upland, although numbers of migrant/transient species at individual sites did not always follow this pattern. Mean number of avian species (including breeders and migrants/transients) per survey plot was greatest near the river, in forested wetland I (7.2 ± 0.3). Remaining forested wetland, areas II and III (5.8 ± 0.3 and 6.2 ± 0.3 respectively) and the upland (5.4 ± 0.3) contained approximately one less species per plot.

Breeding densities of 22 species that were observed 25 or more times in at least one survey zone over the 1998 and 1999 breeding bird seasons were compared between survey zones for each species (Mixed Procedure, orthogonal contrasts) (Table 9, Appendix G). Song Sparrows were observed more often in the forested wetlands than any other species; reaching a high of 2.13 birds per hectare in forested wetland I. Song Sparrow densities near the river were significantly greater than in forested wetland II and the upland (IV) (0.94 and 0.70 birds per hectare, respectively). Similarly, Black-capped Chickadees had significantly higher densities in forested wetland II (0.86 birds ha^{-1}) and III (0.83 birds ha^{-1}), than in forested wetland I (0.36 birds ha^{-1}), but there was no difference between the wetlands and the upland habitat (F=2.32, P=0.0763). Downy Woodpeckers were observed more often in forested wetland II (0.66 birds ha^{-1}) than in the upland (0.30 birds ha^{-1}), but no significant distinction could be made between the other forested wetland densities (F=2.06, P=0.1066). The American Robin (F=6.13, P=0.0005), Blue-gray Gnatcatcher (F=8.43, P=0.0001), White-breasted Nuthatch (F=3.28, P=0.221), and Great-crested Flycatcher (F=3.58, P=0.0158) were observed most commonly in forested wetland I, and densities tended to decrease toward the upland. Near the river, approximately one bird per hectare was observed for Robins (0.94 birds ha^{-1}) and Gnatcatchers (0.93 birds ha^{-1}), while about half as many individuals were recorded for the Nuthatches (0.62 birds ha^{-1}) and Flycatchers (0.47 birds ha^{-1}). Two species, Brown Creeper (F=9.72, P=0.0001) and Eastern Wood-Pewee (F=6.95, P=0.0002), were found in the highest densities in forested wetland II and III, respectively. Blue Jays had similar densities in forested wetland II (0.53 birds ha^{-1}) and III (0.51 birds ha^{-1}) and upland zone IV (0.25 birds ha^{-1}). American Goldfinches and Common

Table 9. Densities (birds ha^{-1}) of the most abundant breeding species recorded in each forested wetland and upland survey zone in southern Michigan over the 1998 and 1999 breeding bird seasons. Densities in bold are significantly greater than densities followed by a different letter in other survey zones.

	Avian Density (x)[a]			
Species	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland[b]
Song Sparrow	**2.13a**	0.94b	1.44ab	0.70b
American Redstart	0.95a	0.56a	1.07a	0.39a
American Robin	**0.94a**	**0.88a**	0.49b	0.29b
Blue-gray Gnatcatcher	**0.93a**	0.39bc	0.52b	0.20c
Northern Oriole	0.62a	0.35a	0.26a	0.22a
White-breasted Nuthatch	**0.62a**	**0.54a**	**0.59a**	0.21b
Tufted Titmouse	0.53a	0.47a	0.63a	0.39a
Downy Woodpecker	0.52ab	**0.66a**	0.47ab	0.30b
Great-crested Flycatcher	**0.47a**	**0.33a**	**0.42a**	0.10b
Common Grackle	0.43a	0.63a	0.38a	0.32a
Black-capped Chickadee	0.36b	**0.86a**	**0.83a**	0.56ab
Brown Creeper	0.18bc	**0.59a**	0.35b	0.03c
Blue Jay	0.14b	**0.53a**	**0.51a**	0.25ab
Red-bellied Woodpecker	0.40a	0.46a	0.33a	0.18a
Eastern Wood-Pewee	0.24bc	0.43ab	**0.65a**	0.14c
Red-eyed Vireo	0.38a	0.47a	0.58a	0.44a
American Goldfinch	---	---	---	**0.90a**
Red-winged Blackbird	0.03a	0.36a	0.09a	0.61a
Gray Catbird	0.07a	0.03a	0.01a	0.61a
Northern Cardinal	0.40a	0.18a	0.29a	0.53a
Common Yellowthroat	---	---	---	**0.44a**
Wood Thrush	0.03a	0.06a	0.13a	0.41a

[a]For each species density values followed by the same letter do not differ significantly ($P>0.05$) as determined by ANOVA (orthogonal contrast). Dashes = no evidence of breeding.

Yellowthroats were not observed breeding in the forested wetland habitat.

Ten additional breeding species of low abundance were observed to have significantly different breeding densities across survey zones (Table 10). Seven species were observed in the highest densities near the river in forested wetland I. The Least Flycatcher (F=5.37, P=0.0014), Eastern Phoebe (F=2.70, P=0.0468), Tree Swallow (F=2.83, P=0.0397), Northern Rough-winged Swallow (F=2.71, P=0.0460), Warbling Vireo (F=11.10, P=0.0001), Northern Parula Warbler (F=3.39, P=0.0190), and Prothonotary Warbler (F=5.74, P=0.0009), all occurred in survey zone I more often than within the other three zones (Mixed Procedure, orthogonal contrasts). Five of these six species (excluding Eastern Phoebe) were not observed at any time within the upland zone. Hairy Woodpeckers seemed to prefer the wetlands over the upland habitat (F=3.12, P=0.0272). Two species, the Ovenbird (F=3.55, P=0.0154) and Blue-winged Warbler (F=5.95, P=0.0007) were found to have greater densities in the upland as compared to forested wetlands.

Table 10. Breeding species of low abundance exhibiting significant differences in densities (birds ha^{-1}) across forested wetland and upland survey zones in southern Michigan during the 1998 and 1999 breeding seasons. Densities in bold are significantly greater than densities in other survey zones.

	Avian Density (x)[a]			
Species	**I-Forested Wetland**	**II-Forested Wetland**	**III-Forested Wetland**	**4-Upland**
Least Flycatcher	**0.16a**	0.01b	0.02b	---
Eastern Phoebe	**0.12a**	0.02b	---	0.02b
Tree Swallow	**0.16a**	0.03b	---	---
Northern Rough-winged Swallow	**0.06a**	---	---	---
Warbling Vireo	**0.29a**	0.03b	0.03b	---
Northern Parula Warbler	**0.04a**	---	---	---
Prothonotary Warbler	**0.39a**	0.17b	0.00b	---
Hairy Woodpecker	**0.22a**	**0.34a**	**0.19ab**	0.04b
Ovenbird	0.00b	---	---	**0.15a**
Blue-winged Warbler	---	---	---	**0.11a**

[a]For each species density values followed by the same letter do not differ significantly ($P>0.05$) as determined by ANOVA (orthogonal contrast). Dashes = no evidence of breeding.

DISCUSSION

Trends in ground water depths were similar across forested wetland survey zones, while the uplands had consistently lower ground water levels compared with the forested wetland zones. The river bank zone (I) had a greater depth to the groundwater level than zones II and III. In addition to elevation, other variables such as soil texture, soil aeration, and internal drainage can also affect local water levels (Robertson et al. 1978).

Forested wetland areas supported significantly less trees and shrubs than in the adjacent upland zone. Although woody plant densities were not statistically different between forested wetland zones, structural characteristics of the vegetation were significantly different from the upland forests. Forest stands with the largest trees, and greatest total basal area, were located near the river in forested wetland zones I and II. Mean size of individual trees and total basal area decreased moving away from the river into the upland where stands were composed of more numerous, younger trees. Mean tree and shrub densities in the forested wetlands were similar to eastern hardwood swamps (Ehrenfeld and Gulick 1981), but considerably less than some southern bottomlands and subtropical areas (Conner et al. 1981, Pool et al. 1977). Mean basal area was greater in southern Michigan forested wetlands than in most mixed hardwood floodplain forests (Brinson 1990), including southern lowland forests in Wisconsin (Curtis 1959). Basal area was not statistically different from continuous silver maple and elm dominated floodplain stands in New Brunswick (Prince 1968). Poor understory development in southern Michigan forested wetlands was consistent with references made to the reduced shrub and sapling densities of many riverine forests (Conner et al. 1981, Smith 1996, Bledsoe and Shear 2000). Unfavorable growth conditions in the

forested wetland understory are likely due to light limitation caused by high canopy closure (Marks and Harcombe 1981), and to seasonal flooding (Bell 1974).

Like the vegetation structure, vegetation composition was different between forested wetland and upland habitats. Species richness in most sites was much greater in upland areas than in the wetland zones, which had similar numbers of tree and shrub species. Bledsoe and Shear (2000) and Brinson (1990) documented similar trends in species richness, where a decrease in site flooding frequency resulted in an increase in the number of tree and shrub species. Upland forests in southern Michigan supported more tree species (36 species) than typical stands in southern Wisconsin (29 species) (Curtis 1959). Southern Michigan forested wetlands had similar numbers of tree species as several other Eastern United States riverine forests, and considerably more species than most Western U.S. floodplains (Brinson 1990). For example, 24 tree species were identified in a New Jersey mixed hardwood floodplain (Frye and Quinn 1979), while a mixed stand in North Dakota contained only nine (Johnson et al. 1976).

Importance values were greatest for several facultative and obligate wetland species across all forested wetland zones. Silver maple and green ash were common dominants within the entire floodplain canopy, with the addition of American elm as a dominant in the wetter zones of the floodplain (II and III). Buell and Wistendahl (1955) described a very similar association of trees in the floodplain of the Raritan River, New Jersey. On the inner floodplain where a series of ridges and poorly drained sloughs were created through erosion, they found silver maple was the top dominant, followed by red maple, green ash, and American elm. Similar communities were found along the St. Lawrence River in Ontario and Quebec, where silver maple dominated forests were

associated with riverine sites having low summer water levels; while wetter conditions supported a combination of silver maple, green ash, American elm, black ash (*Fraxinus nigra*), and yellow birch (*Betula lutea*) (Jean and Bouchard 1993).

The upland zone shared no dominant species with the floodplains, and had fewer dominant trees and shrubs than in most floodplain areas. Upland dominants included only sugar maple and red oak, both facultative upland species. These species were also highly dominant in the mesic and xeric forests of southern Wisconsin (Curtis 1959).

Avian community composition is determined by local food resources, the availability of suitable territory for breeding and nesting, and the structural composition of the habitat (Cody 1981, Bibby et al. 1992). Smith (1977) discovered that in forested habitats, the moisture gradient reflected in the local vegetation structure was an important factor determining the distribution of the birds. Similarly, Douglas et al. (1992) found that avian-habitat associations in riparian zones were primarily influenced by vegetation composition, which was determined by soil moisture. Based on these criteria, we compared the avian community in two forested habitats, the floodplain wetland and the adjacent upland, along major river systems in southern Michigan.

Several bird species found utilizing our study areas deserve noting here. The Acadian Flycatcher and Cerulean Warbler were recorded as breeders in all four survey zones, while the Prothonotary Warbler was discovered breeding exclusively in the forested wetland habitat. These three species are historically classified as "unconfirmed breeders" across most of the southern Michigan region (Brewer et al. 1991). The Cerulean Warbler and Protonotary Warbler are also "species of concern" for the state of Michigan, as are several species observed within our sites that were not recognized as

breeders within the context of our study. These additional species included the Cooper's Hawk, Louisiana Waterthrush, and Hooded Warbler (Michigan Natural Features Inventory 1999). All species of concern within our sites are considered rare or uncommon in the state (21 to 100 occurances), although the Cooper's Hawk is bordering on being secure within Michigan, and the Waterthrush may be more imperiled than the other species due to its rarity and vulnerability to extirpation from the state. Globally, these species are all demonstrably secure, being rare only in parts of their ranges. One species, the Yellow-throated Warbler, is considered "threatened" in Michigan (Michigan Natural Features Inventory 1999). Although it is globally stable, this warbler is critically imperiled in the state because of extreme rarity, and was observed only at the two Maple River sites.

Differences in the breeding bird community were greatest between the forested wetlands and the upland, where variations in the vegetation structure and composition were most pronounced. Breeder abundance and richness were greater in the forested wetlands than within adjacent uplands. This is consistent with the findings of several studies, which reported that floodplain woodlands supported higher densities of breeding birds than did wooded uplands (Dickson 1978, Stauffer and Best 1980). However, Stauffer and Best (1980) found similar numbers of species across both habitats.

A significant number of species responded to the differences between forested wetlands and uplands by breeding exclusively in one of the two habitats. Birds found breeding only in the forested wetland were likely utilizing this habitat for several reasons. Two of the 12 forested wetland breeders, the Least Flycatcher and Prothonotary Warbler, are known to nest in relatively mature deciduous forests and are sensitive to forest

fragmentation (Adams 1995). The wetland stands in southern Michigan were older and often encompassed larger areas than the adjacent upland forests. The wetlands had abundant snags surrounded by contiguous forest, which is essential nesting structure for Red-headed Woodpeckers (Brewer et al. 1991). Red-tailed hawks were also found breeding exclusively in the wetlands in our study. These hawks were likely responding to the large deciduous trees and snags available for nesting sites in the wetland study areas, and not necessarily avoiding the upland zone. Southern Michigan rivers and adjacent floodplains offer nesting and brooding protection for waterfowl, such as the four species identified in this study (Canada Goose, Wood Duck, Mallard, Hooded Merganser) (Bellrose 1980). Tree Swallows, Northern Rough-winged Swallows, Warbling Vireos, and Belted Kingfishers were observed most often along river banks, where they are likely to nest and forage (Brewer et al. 1991).

As compared to the forested wetlands, upland stands provided more suitable breeding habitat for several avian species. Three of the upland breeders require dense shrub cover for nesting, a structure more characteristic in the uplands (Brewer et al. 1991). American Goldfinches, Common Yellowthroats, Willow Flycatchers, and Yellow-billed Cuckoos were found mainly at sites with young trees and an abundance of shrubs. Ground nesters, such as the American Woodcock, Blue-winged Warbler, and Ovenbird require the high, dry substrate of the upland zone (Brewer et al. 1991).

Twenty-two breeding species were observed 25 or more times in at least one survey zone over the duration of the study. Sixteen of these species were also found in Wakely and Roberts' (1996) investigation of bottomland hardwoods along the Cache River in Arkansas. Densities were similar in both studies of forested wetlands for

Northern Orioles, White-breasted Nuthatches, Eastern Wood-Pewees, Red-eyed Vireos, Gray Catbirds, Northern Cardinals, Wood Thrushes, and American Goldfinches. Southern Michigan riverine forests had higher densities of American Redstarts, Common Grackles, Blue Jays, and Red-winged Blackbirds; and lower densities of Blue-gray Gnatcatchers, Tufted Titmice, Downy Woodpeckers, and Great-crested Flycatchers than in Arkansas (Wakely and Roberts 1996).

Almost 50% of the most abundant species had significantly higher breeding densities within the forested wetlands than in the adjacent upland. Song Sparrows were the most abundant species within all three zones of the forested wetland, and had over 2 birds ha^{-1} in forested wetland I. Two other highly abundant species (American Robin and Blue-gray Gnatcatcher) also had their highest densities near the river. Several species exhibited preference for the adjacent forested wetland zones, including Black-capped Chickadees, Brown Creepers, Blue Jays, and Eastern Wood-Pewees. White-breasted Nuthatches, Downy Woodpeckers, and Great-crested Flycatchers were found in fairly equal densities across the riverine forests. In forests along the Kalamazoo River, Song Sparrows were also reported to have the highest density (2.5 birds ha^{-1}) of all birds observed over the duration of the study (Adams et al. 1995). Compared to our study, Adams et al. (1995) found slightly lower densities for Blue-gray Gnatcatchers, Downy Woodpeckers, Great-crested Flycatchers, and Brown Creepers; higher densities for Song Sparrows, American Robins, Black-capped Chickadees, Blue Jays, and Eastern Wood-Pewees; and a similar density for White-breasted Nuthatches. Only two of the highly abundant species, American Goldfinch and the Common Yellowthroat, were observed in significantly higher densities in the upland areas.

Although most structural attributes and vegetation composition were similar for the forested wetland survey zones, the river corridor in forested wetland I had a distinct influence on avian community composition. These findings were similar to the observations of Sanders and Edge (1998) and Whitaker and Montevecchi (1999). Of the 53 breeding species detected at southern Michigan sites, 83% of these were found in forested wetland I. Approximately one-third of the breeding birds having significantly different densities across zones preferred forested wetland I over other wetland and upland areas. Seven species of low abundance (Least Flycatcher, Eastern Phoebe, Tree Swallow, Northern Rough-winged Swallow, Warbling Vireo, Northern Parula Warbler, and Prothonotary Warbler) were found in greater numbers near the river than in all other areas.

The breeding bird community within forested wetland I is not simply the result of an "edge effect", or due to the open canopy structure over the river corridor. If this were the case, we would have found a similar composition and density of bird species at the Maple River 1 site within forested wetland III plot #3, which is adjacent to an open field upland plot. However, no Prothonotary Warblers or Least Flycatchers were found within plot #3; and American Robins, Blue-gray Gnatcatchers, Eastern Phoebes, Northern Rough-winged Swallows, Tree Swallows, and Warbling Vireos all had greatly reduced densities within plot #3 as compared to the river zone plots at this site (no Northern Parula Warblers were found at the Maple River 1 site). Therefore, cutting within the forested wetlands would not attract the same host of breeding species, or species in equal densities, as along the forested river corridor.

Avian species richness, species composition of the local bird community, and densities of individual species were markedly different between forested wetlands and adjacent uplands. Riparian zones in Michigan not only act as movement corridors for many birds (Whitaker and Montevecchi 1999), but are important breeding habitats for an array of avian species not always found in upland sites. There is a recognized need to maintain these riparian zones across the United States because of the multiple benefits they provide for wildlife (Brinson et al 1981). This is true in southern Michigan, where riparian areas provide crucial avian habitat for many species.

Appendix A. List of 47 tree species and 49 shrub species found on 39 vegetation quadrats (1800 m^2 for trees, 900 m^2 for shrubs; 10 quadrats in each forested wetland zone and 9 quadrats in the upland zone) sampled within southern Michigan study sites. Species are grouped by common genera and are listed for each survey zone (Billington 1949, Barnes et al. 1981, Voss 1985 and 1996).

Trees	Shrubs
I-Forested Wetland	
Acer negundo L.[d]	*Acer negundo* L.[d]
Acer rubrum L.[c]	*Carya ovata* (Miller) K. Koch[b]
Acer saccharinum L.[d]	*Celtis occidentalis* L.[c]
Carpinus caroliniana Walter[c]	*Cephalanthus occidentalis* L.[e]
Carya cordiformis (Wang) K.Koch[c]	*Cornus alternifolia* L. f.[a]
Celtis occidentalis L.[c]	*Cornus stolinifera* Michaux[d]
Cercis canadensis L.[b]	*Crataegus sp.* *
Cornus alternifolia L. f.[a]	*Diervilla sp.* *
Crataegus sp. *	*Fraxinus pennsylvanica* Marshall[d]
Fraxinus pennsylvanica Marshall[d]	*Lindera benzoin* (L.) Blume[d]
Gleditsia triacanthos L.[c]	*Rubus occidentalis* L.[a]
Juglans nigra L.[a]	*Rubus strigosus* Michaux[d]
Lindera benzoin (L.) Blume[d]	*Sambucus canadensis* L.[d]
Morus rubra L.[c]	*Staphylea trifolia* L.[c]
Platanus occidentalis L.[d]	*Ulmus americana* L.[d]
Populus deltoides Marsh.[c]	*Ulmus rubra* Muhl.[c]
Prunus serotina Ehrh.[b]	*Vibernum opulus* L.[d]
Prunus virginiana L.[c]	
Quercus bicolor Willd.[d]	
Quercus rubra L.[b]	
Robinia pseudoacacia L.[b]	
Salix amygdaloides Andersson[d]	
Sambucus canadensis L.[d]	
Tilia americana L.[b]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	
II-Forested Wetland	
Acer negundo L.[d]	*Acer rubrum* L.[c]
Acer rubrum L.[c]	*Carpinus caroliniana* Walter[c]
Acer saccharinum L.[d]	*Cephalanthus occidentalis* L.[e]

Appendix A (cont'd).

Trees	Shrubs
II-Forested Wetland (cont'd)	
Acer saccharum Marsh.[b]	*Cornus florida* L.[b]
Carpinus caroliniana Walter[c]	*Cornus foemina* Miller[d]
Carya cordiformis (Wang) K.Koch[c]	*Diervilla sp.* *
Carya laciniosa (Michaux f.) G. Don[d]	*Fraxinus pennsylvanica* Marshall[d]
Celtis occidentalis L.[c]	*Ilex verticillata* (L.) A. Gray[d]
Cornus alternifolia L. f.[a]	*Lindera benzoin* (L.) Blume[d]
Crataegus sp. *	*Ostrya virginiana* (Miller) K. Koch[b]
Fraxinus americana L.[b]	*Quercus bicolor* Willd.[d]
Fraxinus nigra Marshall[d]	*Rosa palustris* Marsh.[e]
Fraxinus pennsylvanica Marshall[d]	*Sambucus canadensis* L.[d]
Hamamelis virginiana L.[b]	*Staphylea trifolia* L.[c]
Platanus occidentalis L.[d]	*Ulmus americana* L.[d]
Populus deltoides Marsh.[c]	*Vibernum opulus* L.[d]
Quercus bicolor Willd.[d]	
Quercus muehlenbergii Engelm.[c]	
Salix amygdaloides Andersson[d]	
Salix nigra Marsh.[e]	
Tilia americana L.[b]	
Ulmus americana L.[d]	
III-Forested Wetland	
Acer negundo L.[d]	*Carpinus caroliniana* Walter[c]
Acer rubrum L.[c]	*Carya laciniosa* (Michaux f.) G. Don[d]
Acer saccharinum L.[d]	*Celtis occidentalis* L.[c]
Acer saccharum Marsh.[b]	*Cephalanthus occidentalis* L.[e]
Carpinus caroliniana Walter[c]	*Cornus amomum* Miller[d]
Carya cordiformis (Wang) K.Koch[c]	*Cornus foemina* Miller[d]
Carya laciniosa (Michaux f.) G. Don[d]	*Diervilla sp.* *
Celtis occidentalis L.[c]	*Fraxinus pennsylvanica* Marshall[d]
Cornus alternifolia L. f.[a]	*Lindera benzoin* (L.) Blume[d]
Crataegus sp. *	*Quercus bicolor* Willd.[d]
Fagus grandifolia Ehrh.[b]	*Staphylea trifolia* L.[c]
Fraxinus americana L.[b]	*Tilia americana* L.[b]
Fraxinus pennsylvanica Marshall[d]	*Ulmus americana* L.[d]
Lindera benzoin (L.) Blume[d]	*Vibernum lentago* L.[c]
Malus pumila Miller[a]	*Vibernum opulus* L.[d]

Appendix A (cont'd).

Trees	Shrubs
III-Forested Wetland (cont'd)	
Ostrya virginiana (Miller) K. Koch[b]	
Platanus occidentalis L.[d]	
Prunus virginiana L.[c]	
Quercus bicolor Willd.[d]	
Salix amygdaloides Andersson[d]	
Salix nigra Marsh.[e]	
Sambucus canadensis L.[d]	
Tilia americana L.[b]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	
IV-Upland	
Acer negundo L.[d]	*Acer nigrum* Michaux f.[b]
Acer nigrum Michaux f.[b]	*Acer rubrum* L.[c]
Acer rubrum L.[c]	*Acer saccharum* Marsh.[b]
Acer saccharinum L.[d]	*Asimina triloba* (L.) Dunal[c]
Acer saccharum Marsh.[b]	*Carpinus caroliniana* Walter[c]
Asimina triloba (L.) Dunal[c]	*Carya cordiformis* (Wang.) K. Koch[c]
Carpinus caroliniana Walter[c]	*Carya ovata* (Miller) K. Koch[b]
Carya cordiformis (Wang) K.Koch[c]	*Cephalanthus occidentalis* L.[e]
Carya ovata (Miller) K.Koch[b]	*Cornus alternifolia* L. f.[a]
Celtis occidentalis L.[c]	*Cornus amomum* Miller[d]
Cornus florida L.[b]	*Cornus florida* L.[b]
Crataegus sp. *	*Cornus foemina* Miller[d]
Fagus grandifolia Ehrh.[b]	*Cornus stolinifera* Michaux[d]
Fraxinus americana L.[b]	*Crataegus sp.* *
Fraxinus pennsylvanica Marshall[d]	*Diervilla sp.* *
Hamamelis virginiana L.[b]	*Fagus grandifolia* Ehrh.[b]
Juglans cinerea L.[b]	*Fraxinus americana* L.[b]
Juglans nigra L.[b]	*Fraxinus pennsylvanica* Marshall[d]
Lindera benzoin (L.) Blume[d]	*Hamamelis virginiana* L.[b]
Malus pumila Miller[a]	*Juglans nigra* L.[b]
Morus rubra L.[c]	*Lindera benzoin* (L.) Blume[d]
Ostrya virginiana (Miller) K. Koch[b]	*Malus pumila* Miller[a]
Pinus strobus L.[b]	*Ostrya virginiana* (Miller) K. Koch[b]
Populus deltoides Marsh.[c]	*Populus deltoides* Marsh.[c]

Appendix A (cont'd).

Trees	Shrubs
IV-Upland (cont'd)	
Populus tremuloides Michaux[c]	*Prunus serotina* Ehrh.[b]
Prunus serotina Ehrh.[b]	*Prunus virginiana* L.[c]
Prunus virginiana L.[c]	*Ptelea trifoliata* L.[b]
Quercus alba L.[b]	*Quercus alba* L.[b]
Quercus bicolor Willd.[d]	*Quercus bicolor* Willd.[d]
Quercus coccinia Muenchh.[a]	*Quercus rubra* L.[b]
Quercus rubra L.[b]	*Ribes cynosbatti* L.[a]
Salix exigua Nutt.[e]	*Rosa palustris* Marsh.[e]
Salix nigra Marsh.[e]	*Rosa spp**
Sassafras albidum (Nutt.) Nees[b]	*Rubus occidentalis* L.[a]
Tilia americana L.[b]	*Rubus strigosus* Michaux[d]
Ulmus americana L.[d]	*Salix exigua* Nutt.[e]
Ulmus rubra Muhl.[c]	*Staphylea trifolia* L.[c]
	Tilia americana L.[b]
	Ulmus americana L.[d]
	Ulmus rubra Muhl.[c]
	Vibernum opulus L.[d]
	Vitis riparia Michaux[d]
	Zanthoxylum americanum Miller[a]

*Similar species grouped into genera.

[a]Upland; almost always occurs in uplands (>99% probability)

[b]Facultative Upland; usually occurs in non-wetlands (1%-33% probability in wetlands)

[c]Facultative; equally likely to occur in wetlands or non-wetlands (34%-66% probability)

[d]Facultative Wetland; usually occurs in wetlands (67%-99% probability in wetlands)

[e]Obligate; almost always occurs in wetlands under natural conditions (>99% probability)

Appendix B. List of 47 tree species and 49 shrub species found on vegetation quadrats (1800 m^2 for trees, 900 m^2 for shrubs; 2 quadrats per zone per site except Red Cedar upland-1 quadrat) sampled within each southern Michigan study site. Species are grouped by common genera and are listed for each survey zone (Billington 1949, Barnes et al. 1981, Voss 1985 and 1996).

Allegan State Game Area	
Trees	**Shrubs**
I-Forested Wetland	
Acer negundo L.[d]	*Acer negundo* L.[d]
Acer saccharinum L.[d]	*Celtis occidentalis* L.[c]
Celtis occidentalis L.[c]	*Cephalanthus occidentalis* L.[e]
*Crataegus sp.**	*Cornus stolinifera* Michaux[d]
Fraxinus pennsylvanica Marshall[d]	*Fraxinus pennsylvanica* Marshall[d]
Gleditsia triacanthos L.[c]	*Lindera benzoin* (L.) Blume[d]
Juglans nigra L.[a]	*Rubus occidentalis* L.[a]
Lindera benzoin (L.) Blume[d]	*Rubus strigosus* Michaux[d]
Morus rubra L.[c]	*Sambucus canadensis* L.[d]
Platanus occidentalis L.[d]	*Staphylea trifolia* L.[c]
Prunus virginiana L.[c]	*Ulmus americana* L.[d]
Sambucus canadensis L.[d]	*Ulmus rubra* Muhl.[c]
Tilia americana L.[b]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	
II-Forested Wetland	
Acer saccharinum L.[d]	*Lindera benzoin* (L.) Blume[d]
Fraxinus pennsylvanica Marshall[d]	
Platanus occidentalis L.[d]	
Salix amygdaloides Andersson[d]	
Ulmus americana L.[d]	
III-Forested Wetland	
Acer negundo L.[d]	*Cephalanthus occidentalis* L.[e]
Acer saccharinum L.[d]	*Fraxinus pennsylvanica* Marshall[d]
Celtis occidentalis L.[c]	*Lindera benzoin* (L.) Blume[d]
Cornus alternifolia L. f.[a]	*Sambucus canadensis* L.[d]
*Crataegus sp.**	*Ulmus americana* L.[d]
Fraxinus pennsylvanica Marshall[d]	
Lindera benzoin (L.) Blume[d]	

Appendix B (cont'd).

Allegan State Game Area (cont'd)

Trees	Shrubs
III-Forested Wetland (cont'd)	
Sambucus canadensis L.[d]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	
IV-Upland	
Acer rubrum L.[c]	*Acer rubrum* L.[c]
Acer saccharinum L.[d]	*Acer saccharum* Marsh.[b]
Acer saccharum Marsh.[b]	*Carpinus caroliniana* Walter[c]
Carpinus caroliniana Walter[c]	*Carya cordiformis* (Wang.) K. Koch[c]
Carya cordiformis (Wang) K.Koch[c]	*Cephalanthus occidentalis* L.[e]
Cornus florida L.[b]	*Cornus florida* L.[b]
*Crataegus sp.**	*Cornus foemina* Miller[d]
Fraxinus americana L.[b]	*Crataegus sp.**
Hamamelis virginiana L.[b]	*Fagus grandifolia* Ehrh.[b]
Juglans cinerea L.[b]	*Fraxinus americana* L.[b]
Juglans nigra L.[b]	*Hamamelis virginiana* L.[b]
Lindera benzoin (L.) Blume[d]	*Lindera benzoin* (L.) Blume[d]
Pinus strobus L.[b]	*Ostrya virginiana* (Miller) K. Koch[b]
Populus tremuloides Michaux[c]	*Prunus serotina* Ehrh.[b]
Prunus serotina Ehrh.[b]	*Prunus virginiana* L.[c]
Prunus virginiana L.[c]	*Ribes cynosbatti* L.[a]
Quercus alba L.[b]	*Ulmus americana* L.[d]
Quercus rubra L.[b]	*Vibernum opulus* L.[d]
Sassafras albidum (Nutt.) Nees[b]	*Zanthoxylum americanum* Miller[a]
Tilia americana L.[b]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	

Augusta Floodplain Reserve

Trees	Shrubs
I-Forested Wetland	
Acer rubrum L.[c]	*Celtis occidentalis* L.[c]
Acer saccharinum L.[d]	*Fraxinus pennsylvanica* Marshall[d]
Carpinus caroliniana Walter[c]	*Lindera benzoin* (L.) Blume[d]

Appendix B (cont'd).

Augusta Floodplain Reserve (cont'd)	
Trees	**Shrubs**
I-Forested Wetland (cont'd)	
Carya cordiformis (Wang) K.Koch[c]	*Staphylea trifolia* L.[c]
Celtis occidentalis L.[c]	
Cercis canadensis L.[b]	
Fraxinus pennsylvanica Marshall[d]	
Platanus occidentalis L.[d]	
Prunus virginiana L.[c]	
Quercus bicolor Willd.[d]	
Quercus rubra L.[b]	
Tilia americana L.[b]	
Ulmus americana L.[d]	
II-Forested Wetland	
Acer rubrum L.[c]	*Acer rubrum* L.[c]
Acer saccharinum L.[d]	*Carpinus caroliniana* Walter[c]
Acer saccharum Marsh.[b]	*Cephalanthus occidentalis* L.[e]
Carpinus caroliniana Walter[c]	*Cornus florida* L.[b]
Carya cordiformis (Wang) K.Koch[c]	*Cornus foemina* Miller[d]
Fraxinus americana L.[b]	*Fraxinus pennsylvanica* Marshall[d]
Fraxinus pennsylvanica Marshall[d]	*Ilex verticillata* (L.) A. Gray[d]
Hamamelis virginiana L.[b]	*Lindera benzoin* (L.) Blume[d]
Quercus bicolor Willd.[d]	*Ostrya virginiana* (Miller) K. Koch[b]
Quercus muehlenbergii Engelm.[c]	*Quercus bicolor* Willd.[d]
Tilia americana L.[b]	*Staphylea trifolia* L.[c]
Ulmus americana L.[d]	*Ulmus americana* L.[d]
III-Forested Wetland	
Acer rubrum L.[c]	*Carpinus caroliniana* Walter[c]
Acer saccharinum L.[d]	*Cephalanthus occidentalis* L.[e]
Acer saccharum Marsh.[b]	*Fraxinus pennsylvanica* Marshall[d]
Carpinus caroliniana Walter[c]	*Lindera benzoin* (L.) Blume[d]
Carya cordiformis (Wang) K.Koch[c]	*Quercus bicolor* Willd.[d]
Fagus grandifolia Ehrh.[b]	*Staphylea trifolia* L.[c]
Fraxinus americana L.[b]	*Tilia americana* L.[b]
Fraxinus pennsylvanica Marshall[d]	*Ulmus americana* L.[d]
Ostrya virginiana (Miller) K. Koch[b]	

Appendix B (cont'd).

Augusta Floodplain Reserve (cont'd)

Trees	Shrubs
III-Forested Wetland (cont'd)	
Prunus virginiana L.[c]	
Quercus bicolor Willd.[d]	
Tilia americana L.[b]	
Ulmus americana L.[d]	
IV-Upland	
Acer saccharinum L.[d]	*Acer saccharum* Marsh.[b]
Acer saccharum Marsh.[b]	*Asimina triloba* (L.) Dunal[c]
Asimina triloba (L.) Dunal[c]	*Carpinus caroliniana* Walter[c]
Carpinus caroliniana Walter[c]	*Cephalanthus occidentalis* L.[e]
Carya cordiformis (Wang) K.Koch[c]	*Cornus florida* L.[b]
Crataegus sp. *	*Cornus foemina* Miller[d]
Fagus grandifolia Ehrh.[b]	*Cornus stolinifera* Michaux[d]
Fraxinus americana L.[b]	*Fagus grandifolia* Ehrh.[b]
Fraxinus pennsylvanica Marshall[d]	*Fraxinus pennsylvanica* Marshall[d]
Lindera benzoin (L.) Blume[d]	*Hamamelis virginiana* L.[b]
Ostrya virginiana (Miller) K. Koch[b]	*Lindera benzoin* (L.) Blume[d]
Prunus serotina Ehrh.[b]	*Ostrya virginiana* (Miller) K. Koch[b]
Quercus bicolor Willd.[d]	*Prunus serotina* Ehrh.[b]
Quercus rubra L.[b]	*Rosa palustris* Marsh.[e]
Tilia americana L.[b]	*Salix exigua* Nutt.[e]
Ulmus americana L.[d]	*Staphylea trifolia* L.[c]

Maple River State Game Area - 1

Trees	Shrubs
I-Forested Wetland	
Acer negundo L.[d]	*Carya ovata* (Miller) K. Koch[b]
Acer saccharinum L.[d]	*Celtis occidentalis* L.[c]
Carya cordiformis (Wang) K.Koch[c]	*Cephalanthus occidentalis* L.[e]
Celtis occidentalis L.[c]	*Crataegus sp.* *
Crataegus sp. *	*Fraxinus pennsylvanica* Marshall[d]
Fraxinus pennsylvanica Marshall[d]	*Vibernum opulus* L.[d]
Platanus occidentalis L.[d]	
Populus deltoides Marsh.[c]	

Appendix B (cont'd).

Maple River State Game Area - 1 (cont'd)	
Trees	**Shrubs**
I-Forested Wetland (cont'd)	
Quercus bicolor Willd.[d]	
II-Forested Wetland	
Acer saccharinum L.[d]	*Cephalanthus occidentalis* L.[e]
Carya laciniosa (Michaux f.) G. Don[d]	*Fraxinus pennsylvanica* Marshall[d]
Platanus occidentalis L.[d]	
Populus deltoides Marsh.[c]	
Ulmus americana L.[d]	
III-Forested Wetland	
Acer saccharinum L.[d]	*Carya laciniosa* (Michaux f.) G. Don[d]
Carya laciniosa (Michaux f.) G. Don[d]	*Fraxinus pennsylvanica* Marshall[d]
Celtis occidentalis L.[c]	
Crataegus sp. *	
Fraxinus pennsylvanica Marshall[d]	
Malus pumila Miller[a]	
Quercus bicolor Willd.[d]	
Ulmus americana L.[d]	
Ulmus rubra Muhl.[c]	
IV-Upland	
Acer negundo L.[d]	*Cornus amomum* Miller[d]
Fraxinus americana L.[b]	*Fraxinus americana* L.[b]
Fraxinus pennsylvanica Marshall[d]	*Populus deltoides* Marsh.[c]
Populus deltoides Marsh.[c]	*Rosa palustris* Marsh.[e]
Salix exigua Nutt.[e]	*Salix exigua* Nutt.[e]
Ulmus americana L.[d]	

Maple River State Game Area - 2	
Trees	**Shrubs**
I-Forested Wetland	
Acer negundo L.[d]	*Sambucus canadensis* L.[d]
Acer saccharinum L.[d]	*Vibernum opulus* L.[d]
Celtis occidentalis L.[c]	

Appendix B (cont'd).

Maple River State Game Area - 2 (cont'd)	
Trees	**Shrubs**
I-Forested Wetland (cont'd)	
Crataegus sp. *	
Fraxinus pennsylvanica Marshall[d]	
Juglans nigra L.[a]	
Populus deltoides Marsh.[c]	
Quercus bicolor Willd.[d]	
Ulmus americana L.[d]	
II-Forested Wetland	
Acer saccharinum L.[d]	*Cephalanthus occidentalis* L.[e]
Fraxinus nigra Marshall[d]	*Fraxinus pennsylvanica* Marshall[d]
Fraxinus pennsylvanica Marshall[d]	*Lindera benzoin* (L.) Blume[d]
Quercus bicolor Willd.[d]	*Vibernum opulus* L.[d]
Salix nigra Marsh.[e]	
Ulmus americana L.[d]	
III-Forested Wetland	
Carya cordiformis (Wang) K.Koch[c]	*Fraxinus pennsylvanica* Marshall[d]
Celtis occidentalis L.[c]	*Lindera benzoin* (L.) Blume[d]
Crataegus sp. *	*Vibernum opulus* L.[d]
Fraxinus pennsylvanica Marshall[d]	
Quercus bicolor Willd.[d]	
Salix nigra Marsh.[e]	
Ulmus americana L.[d]	
IV-Upland	
Acer negundo L.[d]	*Acer nigrum* Michaux f.[b]
Acer nigrum Michaux f.[b]	*Carpinus caroliniana* Walter[c]
Acer rubrum L.[c]	*Carya cordiformis* (Wang.) K. Koch[c]
Acer saccharum Marsh.[b]	*Carya ovata* (Miller) K. Koch[b]
Carpinus caroliniana Walter[c]	*Cornus alternifolia* L. f.[a]
Carya cordiformis (Wang) K.Koch[c]	*Cornus foemina* Miller[d]
Carya ovata (Miller) K.Koch[b]	*Crataegus sp.* *
Celtis occidentalis L.[c]	*Fraxinus americana* L.[b]
Crataegus sp. *	*Fraxinus pennsylvanica* Marshall[d]
Fagus grandifolia Ehrh.[b]	*Juglans nigra* L.[b]

Appendix B (cont'd).

Maple River State Game Area - 2 (cont'd)

Trees	Shrubs
IV-Upland (cont'd)	
Fraxinus americana L.[b]	*Malus pumila* Miller[a]
Fraxinus pennsylvanica Marshall[d]	*Ostrya virginiana* (Miller) K. Koch[b]
Juglans cinerea L.[b]	*Prunus serotina* Ehrh.[b]
Juglans nigra L.[b]	*Quercus alba* L.[b]
Malus pumila Miller[a]	*Quercus bicolor* Willd.[d]
Morus rubra L.[c]	*Quercus rubra* L.[b]
Ostrya virginiana (Miller) K. Koch[b]	*Ribes cynosbatti* L.[a]
Prunus serotina Ehrh.[b]	*Rosa palustris* Marsh.[e]
Prunus virginiana L.[c]	*Rosa spp**
Quercus alba L.[b]	*Rubus occidentalis* L.[a]
Quercus bicolor Willd.[d]	*Rubus strigosus* Michaux[d]
Quercus coccinia Muenchh.[a]	*Staphylea trifolia* L.[c]
Quercus rubra L.[b]	*Tilia americana* L.[b]
Tilia americana L.[b]	*Ulmus americana* L.[d]
Ulmus americana L.[d]	*Ulmus rubra* Muhl.[c]
Ulmus rubra Muhl.[c]	*Vibernum opulus* L.[d]
	Vitis riparia Michaux[d]
	Zanthoxylum americanum Miller[a]

Red Cedar Riverwalk Crego Park

Trees	Shrubs
I-Forested Wetland	
Acer negundo L.[d]	*Cephalanthus occidentalis* L.[e]
Acer saccharinum L.[d]	*Cornus alternifolia* L. f.[a]
Celtis occidentalis L.[c]	*Diervilla sp.**
Cornus alternifolia L. f.[a]	*Rubus strigosus* Michaux[d]
*Crataegus sp.**	*Staphylea trifolia* L.[c]
Fraxinus pennsylvanica Marshall[d]	*Vibernum opulus* L.[d]
Platanus occidentalis L.[d]	
Populus deltoides Marsh.[c]	
Prunus serotina Ehrh.[b]	
Robinia pseudoacacia L.[b]	
Salix amygdaloides Andersson[d]	
Ulmus americana L.[d]	

Appendix B (cont'd).

Red Cedar Riverwalk Crego Park (cont'd)

Trees	Shrubs
II-Forested Wetland	
Acer negundo L.[d]	*Cephalanthus occidentalis* L.[e]
Acer saccharinum L.[d]	*Diervilla sp.* *
Celtis occidentalis L.[c]	*Fraxinus pennsylvanica* Marshall[d]
Cornus alternifolia L. f.[a]	*Rosa palustris* Marsh.[e]
Crataegus sp. *	*Vibernum opulus* L.[d]
Fraxinus pennsylvanica Marshall[d]	
Populus deltoides Marsh.[c]	
Salix amygdaloides Andersson[d]	
Ulmus americana L.[d]	
III-Forested Wetland	
Acer negundo L.[d]	*Celtis occidentalis* L.[c]
Acer saccharinum L.[d]	*Cephalanthus occidentalis* L.[e]
Crataegus sp. *	*Cornus amomum* Miller[d]
Fraxinus pennsylvanica Marshall[d]	*Cornus foemina* Miller[d]
Salix amygdaloides Andersson[d]	*Diervilla sp.* *
Ulmus americana L.[d]	*Vibernum lentago* L.[c]
IV-Upland	
Acer negundo L.[d]	*Cornus alternifolia* L. f.[a]
Acer saccharinum L.[d]	*Cornus foemina* Miller[d]
Acer saccharum Marsh.[b]	*Diervilla sp.* *
Crataegus sp. *	*Fraxinus americana* L.[b]
Fraxinus americana L.[b]	*Prunus serotina* Ehrh.[b]
Fraxinus pennsylvanica Marshall[d]	*Ptelea trifoliata* L.[b]
Juglans cinerea L.[b]	*Quercus rubra* L.[b]
Juglans nigra L.[b]	*Salix exigua* Nutt.[e]
Malus pumila Miller[a]	
Populus deltoides Marsh.[c]	
Prunus serotina Ehrh.[b]	
Quercus alba L.[b]	
Quercus coccinia Muenchh.[a]	
Quercus rubra L.[b]	
Salix nigra Marsh.[e]	
Ulmus americana L.[d]	

Appendix B (cont'd).

Red Cedar Riverwalk Crego Park (cont'd)	
Trees	**Shrubs**
IV-Upland (cont'd)	
Ulmus rubra Muhl.[c]	

*Similar species grouped into genera.

[a]Upland; almost always occurs in uplands (>99% probability)

[b]Facultative Upland; usually occurs in non-wetlands (1%-33% probability in wetlands)

[c]Facultative; equally likely to occur in wetlands or non-wetlands (34%-66% probability)

[d]Facultative Wetland; usually occurs in wetlands (67%-99% probability in wetlands)

[e]Obligate; almost always occurs in wetlands under natural conditions (>99% probability)

Appendix C. Importance values for tree species and shrub species found in forested wetland and upland survey zones in southern Michigan study sites. Maximum importance values =300 for trees, and =200 for shrubs in each survey zone.

	Importance Value			
Species	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Trees				
Acer negundo L.	16	4	7	3
Acer nigrum Michaux	0	0	0	5
Acer rubrum L.	4	9	7	4
Acer saccharinum L.	104	98	70	8
Acer saccharum Marsh.	0	2	3	35
Asimina triloba (L.) Dunal	0	0	0	1
Carpinis caroliniana Walter	9	12	15	7
Carya cordiformis (Wang) K.Koch	5	2	5	10
Carya laciniosa (Michaux f.) G. Don	0	2	2	0
Carya ovata (Miller) K.Koch	0	0	0	3
Celtis occidentalis L.	11	3	6	1
Cercis canadensis L.	2	0	0	0
Cornus alternifolia L. f.	1	2	1	0
Cornus florida L.	0	0	0	4
*Crataegus sp.**	11	4	14	9
Fagus grandifolia Ehrh.	0	0	4	12
Fraxinus americana L.	0	2	3	23
Fraxinus nigra Marshall	0	2	0	0
Fraxinus pennsylvanica Marshall	46	75	91	5
Gleditsia triacanthos L.	2	0	0	0
Hamamelis virginiana L.	0	2	0	12
Juglans cinerea L.	0	0	0	2
Juglans nigra L.	5	0	0	6
Lindera benzoin (L.) Blume	5	0	3	2
Malus pumila Miller	0	0	1	3
Morus rubra L.	1	0	0	1
Ostrya virginiana (Miller) K. Koch	0	0	1	8
Pinus strobus L.	0	0	0	3
Platanus occidentalis L.	10	8	3	0
Populus deltoides Marsh.	13	8	0	18
Populus tremuloides Michaux	0	0	0	4
Prunus serotina Ehrh.	1	0	0	13

Appendix C (cont'd).

Species	Importance Value I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Trees				
Prunus virginiana L.	1	0	1	2
Quercus alba L.	0	0	0	9
Quercus bicolor Willd.	8	17	18	5
Quercus coccinia Muenchh.	0	0	0	4
Quercus muehlenbergii Engelm.	0	2	0	0
Quercus rubra L.	1	0	0	32
Robinia pseudoacacia L.	1	0	0	0
Salix amygdaloides Andersson	2	8	1	0
Salix exigua Nutt.	0	0	0	1
Salix nigra Marsh.	0	2	2	1
Sambucus canadensis L.	1	0	1	0
Sassafras albidum (Nutt.) Nees	0	0	0	1
Tilia americana L.	12	6	5	26
Ulmus americana L.	23	32	30	9
Ulmus rubra Muhl.	4	0	4	9
Shrubs				
Acer negundo L.	6	0	0	0
Acer nigrum Michaux f.	0	0	0	3
Acer rubrum L.	0	4	0	2
Acer saccharum Marsh.	0	0	0	23
Asimina triloba (L.) Dunal	0	0	0	5
Carpinus caroliniana Walter	0	8	8	5
Carya cordiformis (Wang.) K. Koch	0	0	0	5
Carya laciniosa (Michaux f.) G. Don	0	0	4	0
Carya ovata (Miller) K. Koch	3	0	0	2
Celtis occidentalis L.	12	0	3	0
Cephalanthus occidentalis L.	22	33	16	2
Cornus alternifolia L. f.	3	0	0	2
Cornus amomum Miller	0	0	4	2
Cornus florida L.	0	4	0	2
Cornus foemina Miller	0	4	4	20
Cornus stolinifera Michaux	3	0	0	1
*Crataegus sp.**	3	0	0	3

Appendix C (cont'd).

Species	Importance Value I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Shrubs				
*Diervilla sp.**	11	4	9	6
Fagus grandifolia Ehrh.	0	0	0	3
Fraxinus americana L.	0	0	0	9
Fraxinus pennsylvanica Marshall	21	59	26	5
Hamamelis virginiana L.	0	0	0	4
Ilex verticillata (L.) A. Gray	0	4	0	0
Juglans nigra L.	0	0	0	1
Lindera benzoin (L.) Blume	54	55	88	7
Malus pumila Miller	0	0	0	1
Ostrya virginiana (Miller) K. Koch	0	4	0	5
Populus deltoides Marsh.	0	0	0	4
Prunus serotina Ehrh.	0	0	0	8
Prunus virginiana L.	0	0	0	1
Ptelea trifoliata L.	0	0	0	1
Quercus alba L.	0	0	0	1
Quercus bicolor Willd.c	0	4	7	2
Quercus rubra L.	0	0	0	2
Ribes cynosbatti L.	0	0	0	5
Rosa palustris Marsh.	0	4	0	5
*Rosa sp.**	0	0	0	1
Rubus occidentalis L.	6	0	0	3
Rubus strigosus Michaux	7	0	0	1
Salix exigua Nutt.	0	0	0	17
Sambucus canadensis L.	14	0	8	0
Staphylea trifolia L.	8	4	4	2
Tilia americana L.	0	0	4	7
Ulmus americana L.	3	4	7	3
Ulmus rubra Muhl.	3	0	0	2
Vibernum lentago L.	0	0	5	0
Vibernum opulus L.	20	8	3	4
Vitis riparia Michaux	0	0	0	1
Zanthoxylum americanum Miller	0	0	0	10

Appendix D. Total number of logs recorded in riverine floodplain and adjacent upland survey zones across all southern Michigan study sites. All logs within the 39 vegetation quadrats (1800 m^2) and with a diameter greater than 10cm were counted.

	Survey Zone			
Log Width (cm)[a]	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	4-Upland
10	108	293	228	84
20	76	195	124	43
30	23	40	52	30
40	6	12	20	13
50	10	3	5	7
60	2	1	2	1
70	1	0	2	0
80	0	0	0	3
90	0	0	1	1
100	0	1	0	1
120	0	0	1	0
140	0	0	1	0
190	0	0	1	0
200	0	0	0	1
All	**226**	**545**	**437**	**183**
Mean Density (logs ha^{-1})[b]	**132.9b**	**320.6a**	**257.6a**	**133.5b**

[a]Log Width = the largest diameter (cm) of the fallen tree in 10cm size classes.

[b]Mean densities followed by the same letter have statistically similar values.

Appendix E. List of bird species observed over all southern Michigan forested wetland and upland study areas (including within plot, outside of plot, and between plot records) during the 1998 and 1999 breeding bird seasons (Scott 1987).

Family	Species	Common Name
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
	Butorides virescens (Linnaeus)	Green Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
	Anas discors Linnaeus	Blue-winged Teal
	Lophodytes cucullatus Linnaeus	Hooded Merganser
Cathartidae	*Cathartes aura* (Linnaeus)	Turkey Vulture
Accipitridae	*Accipiter cooperii* (Bonaparte)	Cooper's Hawk
	Buteo jamaicensis (Gmelin)	Red-tailed Hawk
Phasianidae	*Phasianus colchicus* Linnaeus	Ring-necked Pheasant
	Meleagris gallopavo Linnaeus	Wild Turkey
	Colinus virginianus (Linnaeus)	Northern Bobwhite
Gruidae	*Grus canadensis* (Linnaeus)	Sandhill Crane
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Scolopacidae	*Actitis macularia* (Linnaeus)	Spotted Sandpiper
	Scolopax minor Gmelin	American Woodcock
Columbidae	*Columba livia* Gmelin	Rock Dove
	Zenaida macroura (Linnaeus)	Mourning Dove
Cuculidae	*Coccyzus erythropthalmus* (Wilson)	Black-billed Cuckoo
	Coccyzus americanus (Linnaeus)	Yellow-billed Cuckoo
Strigidae	*Bubo virginianus* (Gmelin)	Great Horned Owl
	Strix varia Barton	Barred Owl
Apodidae	*Chaetura pelagica* (Linnaeus)	Chimney Swift
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes erythrocephalus* (Linnaeus)	Red-headed Woodpecker
	Melanerpes carolinus (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker
	Picoides villosus (Linnaeus)	Hairy Woodpecker

Appendix E (cont'd).

Family	Species	Common Name
Picidae (cont'd)	*Colaptes auratus* (Linnaeus)	Northern Flicker
	Dryocopus pileatus (Linnaeus)	Pileated Woodpecker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax flaviventris (Baird & Baird)	Yellow-bellied Flycatcher
	Empidonax virescens (Vieillot)	Acadian Flycatcher
	Empidonax alnorum Brewster	Alder Flycatcher
	Empidonax traillii (Audubon)	Willow Flycatcher
	Empidonax minimus (Baird & Baird)	Least Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
	Tyrannus tyrannus (Linnaeus)	Eastern Kingbird
Hirundinidae	*Progne subis* (Linnaeus)	Purple Martin
	Tachycineta bicolor (Vieillot)	Tree Swallow
	Stelgidopteryx serripennis (Audubon)	Northern Rough-winged Swallow
	Hirundo rustica Linnaeus	Barn Swallow
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Troglodytidae	*Thryothorus ludovicianus* (Latham)	Carolina Wren
	Troglodytes aedon Vieillot	House Wren
Muscicapidae	*Regulus calendula* (Linnaeus)	Ruby-crowned Kinglet
	Polioptila caerulea (Linnaeus)	Blue-gray Gnatcatcher
	Sialia sialis (Linnaeus)	Eastern Bluebird
	Catharus fuscescens (Stephens)	Veery
	Catharus minimus (Lafresnaye)	Gray-cheeked Thrush
	Catharus ustulatus (Nuttall)	Swainson's Thrush
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
	Toxostoma rufum (Linnaeus)	Brown Thrasher
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Sturnidae	*Sturnus vulgaris* Linnaeus	European Starling

Appendix E (cont'd).

Family	Species	Common Name
Vireonidae	*Vireo solitarius* (Wilson)	Solitary Vireo
	Vireo flavifrons Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo philadelphicus (Cassin)	Philadelphia Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo
Emberizidae	*Vermivora pinus* (Linnaeus)	Blue-winged Warbler
	Vermivora chrysoptera (Linnaeus)	Golden-winged Warbler
	Vermivora peregrina (Wilson)	Tennessee Warbler
	Vermivora celata (Say)	Orange-crowned Warbler
	Vermivora ruficapilla (Wilson)	Nashville Warbler
	Parula americana (Linnaeus)	Northern Parula Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica pensylvanica (Linnaeus)	Chesnut-sided Warbler
	Dendroica magnolia (Wilson)	Magnolia Warbler
	Dendroica tigrina (Gmelin)	Cape May Warbler
	Dendroica caerulescens (Gmelin)	Black-throated Blue Warbler
	Dendroica coronata (Linnaeus)	Yellow-rumped Warbler
	Dendroica virens (Gmelin)	Black-throated Green Warbler
	Dendroica fusca (Muller)	Blackburnian Warbler
	Dendroica dominica (Linnaeus)	Yellow-throated Warbler
	Dendroica castanea (Wilson)	Bay-breasted Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Mniotilta varia (Linnaeus)	Black-and-white Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Protonotaria citrea (Boddaert)	Prothonotary Warbler
	Seiurus aurocapillus (Linnaeus)	Ovenbird
	Seiurus noveboracensis (Gmelin)	Northern Waterthrush
	Seiurus motacilla (Vieillot)	Louisiana Waterthrush
	Oporornis philadelphia (Wilson)	Mourning Warbler
	Geothlypis trichas (Linnaeus)	Common Yellowthroat
	Wilsonia citrina (Boddaert)	Hooded Warbler
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal
	Pheucticus ludovicianus (Linnaeus)	Rose-breasted Grosbeak
	Passerina cyanea (Linnaeus)	Indigo Bunting
	Pipilo erythrophthalmus (Linnaeus)	Eastern Towhee
	Spizella passerina (Bechstein)	Chipping Sparrow
	Spizella pusilla (Wilson)	Field Sparrow
	Passerculus sandwichensis (Gmelin)	Savannah Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Zonotrichia albicollis (Gmelin)	White-throated Sparrow
	Dolichonyx oryzivorous (Linnaeus)	Bobolink
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Sturnella magna (Linnaeus)	Eastern Meadowlark
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird

Appendix E (cont'd).

Family	Species	Common Name
Emberizidae (cont'd)	*Icterus galbula* (Linnaeus)	Northern Oriole
Fringillidae	*Carpodacus mexicanus* (Muller)	House Finch
	Carduelis tristis (Linnaeus)	American Goldfinch
Passeridae	*Passer domesticus* (Linnaeus)	House Sparrow

Appendix F. List of bird species observed at each southern Michigan study site in forested wetland and upland study areas (including within plot, outside of plot, and between plot records) during the 1998 and 1999 breeding seasons (Scott 1987).

Allegan State Game Area		
Family	**Species**	**Common Name**
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
	Lophodytes cucullatus Linnaeus	Hooded Merganser
Cathartidae	*Cathartes aura* (Linnaeus)	Turkey Vulture
Accipitridae	*Buteo jamaicensis* (Gmelin)	Red-tailed Hawk
Phasianidae	*Meleagris gallopavo* Linnaeus	Wild Turkey
Gruidae	*Grus canadensis* (Linnaeus)	Sandhill Crane
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Cuculidae	*Coccyzus americanus* (Linnaeus)	Yellow-billed Cuckoo
Strigidae	*Strix varia* Barton	Barred Owl
Apodidae	*Chaetura pelagica* (Linnaeus)	Chimney Swift
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes carolinus* (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker
	Picoides villosus (Linnaeus)	Hairy Woodpecker
	Colaptes auratus (Linnaeus)	Northern Flicker
	Dryocopus pileatus (Linnaeus)	Pileated Woodpecker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax virescens (Vieillot)	Acadian Flycatcher
	Empidonax alnorum Brewster	Alder Flycatcher
	Empidonax minimus (Baird & Baird)	Least Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
Hirundinidae	*Tachycineta bicolor* (Vieillot)	Tree Swallow
	Hirundo rustica Linnaeus	Barn Swallow

Appendix F (cont'd).

Allegan State Game Area (cont'd)		
Family	**Species**	**Common Name**
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Muscicapidae	*Polioptila caerulea* (Linnaeus)	Blue-gray Gnatcatcher
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Vireonidae	*Vireo solitarius* (Wilson)	Solitary Vireo
	Vireo flavifrons Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo
Emberizidae	*Vermivora pinus* (Linnaeus)	Blue-winged Warbler
	Vermivora chrysoptera (Linnaeus)	Golden-winged Warbler
	Vermivora peregrina (Wilson)	Tennessee Warbler
	Vermivora celata (Say)	Orange-crowned Warbler
	Vermivora ruficapilla (Wilson)	Nashville Warbler
	Parula americana (Linnaeus)	Northern Parula Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica pensylvanica (Linnaeus)	Chesnut-sided Warbler
	Dendroica coronata (Linnaeus)	Yellow-rumped Warbler
	Dendroica virens (Gmelin)	Black-throated Green Warbler
	Dendroica fusca (Muller)	Blackburnian Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Mniotilta varia (Linnaeus)	Black-and-white Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Protonotaria citrea (Boddaert)	Prothonotary Warbler
	Seiurus aurocapillus (Linnaeus)	Ovenbird
	Seiurus noveboracensis (Gmelin)	Northern Waterthrush
	Seiurus motacilla (Vieillot)	Louisiana Waterthrush
	Geothlypis trichas (Linnaeus)	Common Yellowthroat
	Wilsonia citrina (Boddaert)	Hooded Warbler
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal
	Pheucticus ludovicianus (Linnaeus)	Rose-breasted Grosbeak

Appendix F (cont'd).

Allegan State Game Area (cont'd)		
Family	**Species**	**Common Name**
Emberizidae (cont'd)	*Passerina cyanea* (Linnaeus)	Indigo Bunting
	Pipilo erythrophthalmus (Linnaeus)	Eastern Towhee
	Spizella passerina (Bechstein)	Chipping Sparrow
	Spizella pusilla (Wilson)	Field Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird
	Icterus galbula (Linnaeus)	Northern Oriole
Fringillidae	*Carduelis tristis* (Linnaeus)	American Goldfinch

Augusta Floodplain Reserve		
Family	**Species**	**Common Name**
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
Cathartidae	*Cathartes aura* (Linnaeus)	Turkey Vulture
Accipitridae	*Accipiter cooperii* (Bonaparte)	Cooper's Hawk
	Buteo jamaicensis (Gmelin)	Red-tailed Hawk
Phasianidae	*Meleagris gallopavo* Linnaeus	Wild Turkey
Gruidae	*Grus canadensis* (Linnaeus)	Sandhill Crane
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Scolopacidae	*Actitis macularia* (Linnaeus)	Spotted Sandpiper
	Scolopax minor Gmelin	American Woodcock
Columbidae	*Zenaida macroura* (Linnaeus)	Mourning Dove
Cuculidae	*Coccyzus americanus* (Linnaeus)	Yellow-billed Cuckoo
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes carolinus* (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker
	Picoides villosus (Linnaeus)	Hairy Woodpecker

Appendix F (cont'd).

Augusta Floodplain Reserve (cont'd)

Family	Species	Common Name
Picidae (cont'd)	*Colaptes auratus* (Linnaeus)	Northern Flicker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax virescens (Vieillot)	Acadian Flycatcher
	Empidonax traillii (Audubon)	Willow Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
	Tyrannus tyrannus (Linnaeus)	Eastern Kingbird
Hirundinidae	*Tachycineta bicolor* (Vieillot)	Tree Swallow
	Hirundo rustica Linnaeus	Barn Swallow
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Muscicapidae	*Polioptila caerulea* (Linnaeus)	Blue-gray Gnatcatcher
	Catharus fuscescens (Stephens)	Veery
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Vireonidae	*Vireo solitarius* (Wilson)	Solitary Vireo
	Vireo flavifrons Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo
Emberizidae	*Vermivora peregrina* (Wilson)	Tennessee Warbler
	Vermivora ruficapilla (Wilson)	Nashville Warbler
	Parula americana (Linnaeus)	Northern Parula Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Protonotaria citrea (Boddaert)	Prothonotary Warbler
	Geothlypis trichas (Linnaeus)	Common Yellowthroat
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal

Appendix F (cont'd).

Augusta Floodplain Reserve (cont'd)		
Family	**Species**	**Common Name**
Emberizidae (cont'd)	*Pheucticus ludovicianus* (Linnaeus)	Rose-breasted Grosbeak
	Spizella passerina (Bechstein)	Chipping Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird
	Icterus galbula (Linnaeus)	Northern Oriole
Fringillidae	*Carduelis tristis* (Linnaeus)	American Goldfinch

Maple River State Game Area - 1		
Family	**Species**	**Common Name**
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
	Butorides virescens (Linnaeus)	Green Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
	Lophodytes cucullatus Linnaeus	Hooded Merganser
Accipitridae	*Buteo jamaicensis* (Gmelin)	Red-tailed Hawk
Phasianidae	*Phasianus colchicus* Linnaeus	Ring-necked Pheasant
	Meleagris gallopavo Linnaeus	Wild Turkey
	Colinus virginianus (Linnaeus)	Northern Bobwhite
Gruidae	*Grus canadensis* (Linnaeus)	Sandhill Crane
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Scolopacidae	*Actitis macularia* (Linnaeus)	Spotted Sandpiper
	Scolopax minor Gmelin	American Woodcock
Columbidae	*Zenaida macroura* (Linnaeus)	Mourning Dove
Cuculidae	*Coccyzus erythropthalmus* (Wilson)	Black-billed Cuckoo
	Coccyzus americanus (Linnaeus)	Yellow-billed Cuckoo
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes erythrocephalus* (Linnaeus)	Red-headed Woodpecker
	Melanerpes carolinus (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker

Appendix F (cont'd).

Maple River State Game Area - 1 (cont'd)		
Family	**Species**	**Common Name**
Picidae (cont'd)	*Picoides villosus* (Linnaeus)	Hairy Woodpecker
	Colaptes auratus (Linnaeus)	Northern Flicker
	Dryocopus pileatus (Linnaeus)	Pileated Woodpecker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax virescens (Vieillot)	Acadian Flycatcher
	Empidonax alnorum Brewster	Alder Flycatcher
	Empidonax traillii (Audubon)	Willow Flycatcher
	Empidonax minimus (Baird & Baird)	Least Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
	Tyrannus tyrannus (Linnaeus)	Eastern Kingbird
Hirundinidae	*Tachycineta bicolor* (Vieillot)	Tree Swallow
	Stelgidopteryx serripennis (Audubon)	Northern Rough-winged Swallow
	Hirundo rustica Linnaeus	Barn Swallow
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Troglodytidae	*Troglodytes aedon* Vieillot	House Wren
Muscicapidae	*Polioptila caerulea* (Linnaeus)	Blue-gray Gnatcatcher
	Catharus minimus (Lafresnaye)	Gray-cheeked Thrush
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
	Toxostoma rufum (Linnaeus)	Brown Thrasher
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Sturnidae	*Sturnus vulgaris* Linnaeus	European Starling
Vireonidae	*Vireo flavifrons* Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo philadelphicus (Cassin)	Philadelphia Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo

Appendix F (cont'd).

Maple River State Game Area - 1 (cont'd)		
Family	**Species**	**Common Name**
Emberizidae	*Vermivora pinus* (Linnaeus)	Blue-winged Warbler
	Vermivora peregrina (Wilson)	Tennessee Warbler
	Vermivora ruficapilla (Wilson)	Nashville Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica magnolia (Wilson)	Magnolia Warbler
	Dendroica tigrina (Gmelin)	Cape May Warbler
	Dendroica coronata (Linnaeus)	Yellow-rumped Warbler
	Dendroica virens (Gmelin)	Black-throated Green Warbler
	Dendroica dominica (Linnaeus)	Yellow-throated Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Mniotilta varia (Linnaeus)	Black-and-white Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Protonotaria citrea (Boddaert)	Prothonotary Warbler
	Seiurus aurocapillus (Linnaeus)	Ovenbird
	Seiurus noveboracensis (Gmelin)	Northern Waterthrush
	Oporornis philadelphia (Wilson)	Mourning Warbler
	Geothlypis trichas (Linnaeus)	Common Yellowthroat
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal
	Pheucticus ludovicianus (Linnaeus)	Rose-breasted Grosbeak
	Passerina cyanea (Linnaeus)	Indigo Bunting
	Spizella passerina (Bechstein)	Chipping Sparrow
	Passerculus sandwichensis (Gmelin)	Savannah Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Zonotrichia albicollis (Gmelin)	White-throated Sparrow
	Dolichonyx oryzivorous (Linnaeus)	Bobolink
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Sturnella magna (Linnaeus)	Eastern Meadowlark
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird
	Icterus galbula (Linnaeus)	Northern Oriole
Fringillidae	*Carpodacus mexicanus* (Muller)	House Finch
	Carduelis tristis (Linnaeus)	American Goldfinch

Maple River State Game Area - 2		
Family	**Species**	**Common Name**
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
	Anas discors Linnaeus	Blue-winged Teal
	Lophodytes cucullatus Linnaeus	Hooded Merganser

Appendix F (cont'd).

Maple River State Game Area - 2 (cont'd)		
Family	**Species**	**Common Name**
Cathartidae	*Cathartes aura* (Linnaeus)	Turkey Vulture
Phasianidae	*Phasianus colchicus* Linnaeus	Ring-necked Pheasant
	Meleagris gallopavo Linnaeus	Wild Turkey
Gruidae	*Grus canadensis* (Linnaeus)	Sandhill Crane
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Scolopacidae	*Scolopax minor* Gmelin	American Woodcock
Columbidae	*Columba livia* Gmelin	Rock Dove
	Zenaida macroura (Linnaeus)	Mourning Dove
Cuculidae	*Coccyzus erythropthalmus* (Wilson)	Black-billed Cuckoo
	Coccyzus americanus (Linnaeus)	Yellow-billed Cuckoo
Strigidae	*Strix varia* Barton	Barred Owl
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes carolinus* (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker
	Picoides villosus (Linnaeus)	Hairy Woodpecker
	Colaptes auratus (Linnaeus)	Northern Flicker
	Dryocopus pileatus (Linnaeus)	Pileated Woodpecker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax flaviventris (Baird & Baird)	Yellow-bellied Flycatcher
	Empidonax virescens (Vieillot)	Acadian Flycatcher
	Empidonax minimus (Baird & Baird)	Least Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
Hirundinidae	*Progne subis* (Linnaeus)	Purple Martin
	Tachycineta bicolor (Vieillot)	Tree Swallow
	Stelgidopteryx serripennis (Audubon)	Northern Rough-winged Swallow
	Hirundo rustica Linnaeus	Barn Swallow
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse

Appendix F (cont'd).

Maple River State Game Area - 2 (cont'd)		
Family	**Species**	**Common Name**
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Troglodytidae	*Thryothorus ludovicianus* (Latham)	Carolina Wren
	Troglodytes aedon Vieillot	House Wren
Muscicapidae	*Polioptila caerulea* (Linnaeus)	Blue-gray Gnatcatcher
	Sialia sialis (Linnaeus)	Eastern Bluebird
	Catharus fuscescens (Stephens)	Veery
	Catharus ustulatus (Nuttall)	Swainson's Thrush
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
	Toxostoma rufum (Linnaeus)	Brown Thrasher
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Sturnidae	*Sturnus vulgaris* Linnaeus	European Starling
Vireonidae	*Vireo flavifrons* Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo
Emberizidae	*Vermivora pinus* (Linnaeus)	Blue-winged Warbler
	Vermivora peregrina (Wilson)	Tennessee Warbler
	Vermivora ruficapilla (Wilson)	Nashville Warbler
	Parula americana (Linnaeus)	Northern Parula Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica pensylvanica (Linnaeus)	Chesnut-sided Warbler
	Dendroica magnolia (Wilson)	Magnolia Warbler
	Dendroica tigrina (Gmelin)	Cape May Warbler
	Dendroica caerulescens (Gmelin)	Black-throated Blue Warbler
	Dendroica coronata (Linnaeus)	Yellow-rumped Warbler
	Dendroica virens (Gmelin)	Black-throated Green Warbler
	Dendroica fusca (Muller)	Blackburnian Warbler
	Dendroica dominica (Linnaeus)	Yellow-throated Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Mniotilta varia (Linnaeus)	Black-and-white Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Protonotaria citrea (Boddaert)	Prothonotary Warbler
	Seiurus aurocapillus (Linnaeus)	Ovenbird
	Seiurus noveboracensis (Gmelin)	Northern Waterthrush
	Seiurus motacilla (Vieillot)	Louisiana Waterthrush
	Oporornis philadelphia (Wilson)	Mourning Warbler

Appendix F (cont'd).

Maple River State Game Area - 2 (cont'd)		
Family	**Species**	**Common Name**
Emberizidae (cont'd)	*Geothlypis trichas* (Linnaeus)	Common Yellowthroat
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal
	Pheucticus ludovicianus (Linnaeus)	Rose-breasted Grosbeak
	Passerina cyanea (Linnaeus)	Indigo Bunting
	Spizella passerina (Bechstein)	Chipping Sparrow
	Spizella pusilla (Wilson)	Field Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Zonotrichia albicollis (Gmelin)	White-throated Sparrow
	Dolichonyx oryzivorous (Linnaeus)	Bobolink
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird
	Icterus galbula (Linnaeus)	Northern Oriole
Fringillidae	*Carpodacus mexicanus* (Muller)	House Finch
	Carduelis tristis (Linnaeus)	American Goldfinch

Red Cedar Riverwalk Crego Park		
Family	**Species**	**Common Name**
Ardeidae	*Ardea herodias* Linnaeus	Great Blue Heron
	Butorides virescens (Linnaeus)	Green Heron
Anatidae	*Branta canadensis* Linnaeus	Canada Goose
	Aix sponsa (Linnaeus)	Wood Duck
	Anas platyrynchos Linnaeus	Mallard
	Lophodytes cucullatus Linnaeus	Hooded Merganser
Accipitridae	*Accipiter cooperii* (Bonaparte)	Cooper's Hawk
	Buteo jamaicensis (Gmelin)	Red-tailed Hawk
Charadriidae	*Charadrius vociferus* Linnaeus	Killdeer
Scolopacidae	*Actitis macularia* (Linnaeus)	Spotted Sandpiper
	Scolopax minor Gmelin	American Woodcock
Columbidae	*Columba livia* Gmelin	Rock Dove
	Zenaida macroura (Linnaeus)	Mourning Dove
Cuculidae	*Coccyzus erythropthalmus* (Wilson)	Black-billed Cuckoo
	Coccyzus americanus (Linnaeus)	Yellow-billed Cuckoo
Strigidae	*Bubo virginianus* (Gmelin)	Great Horned Owl
Apodidae	*Chaetura pelagica* (Linnaeus)	Chimney Swift

Appendix F (cont'd).

Red Cedar Riverwalk Crego Park (cont'd)		
Family	**Species**	**Common Name**
Trochilidae	*Archilocus colubris* (Linnaeus)	Ruby-throated Hummingbird
Alcedinidae	*Ceryle alcyon* (Linnaeus)	Belted Kingfisher
Picidae	*Melanerpes erythrocephalus* (Linnaeus)	Red-headed Woodpecker
	Melanerpes carolinus (Linnaeus)	Red-bellied Woodpecker
	Picoides pubescens (Linnaeus)	Downy Woodpecker
	Picoides villosus (Linnaeus)	Hairy Woodpecker
	Colaptes auratus (Linnaeus)	Northern Flicker
Tyrannidae	*Contopus virens* (Linnaeus)	Eastern Wood-Pewee
	Empidonax minimus (Baird & Baird)	Least Flycatcher
	Sayornis phoebe (Latham)	Eastern Phoebe
	Myiarchus crinitus (Linnaeus)	Great Crested Flycatcher
Hirundinidae	*Tachycineta bicolor* (Vieillot)	Tree Swallow
	Stelgidopteryx serripennis (Audubon)	Northern Rough-winged Swallow
	Hirundo rustica Linnaeus	Barn Swallow
Corvidae	*Cyanocitta cristata* (Linnaeus)	Blue Jay
	Corvus brachyrynchos Brehm.	American Crow
Paridae	*Parus atricapillus* Linnaeus	Black-capped Chickadee
	Parus bicolor Linnaeus	Tufted Titmouse
Sittidae	*Sitta carolinensis* Latham	White-breasted Nuthatch
Certhiidae	*Certhia americana* Bonaparte	Brown Creeper
Muscicapidae	*Regulus calendula* (Linnaeus)	Ruby-crowned Kinglet
	Polioptila caerulea (Linnaeus)	Blue-gray Gnatcatcher
	Catharus ustulatus (Nuttall)	Swainson's Thrush
	Hylocichla mustelina (Gmelin)	Wood Thrush
	Turdus migratorius Linnaeus	American Robin
Mimidae	*Dumetella carolinensis* (Linnaeus)	Gray Catbird
Bombycillidae	*Bombycilla cedrorum* Vieillot	Cedar Waxwing
Sturnidae	*Sturnus vulgaris* Linnaeus	European Starling
Vireonidae	*Vireo flavifrons* Vieillot	Yellow-throated Vireo
	Vireo gilvus (Vieillot)	Warbling Vireo
	Vireo olivaceus (Linnaeus)	Red-eyed Vireo

Appendix F (cont'd).

Red Cedar Riverwalk Crego Park (cont'd)		
Family	**Species**	**Common Name**
Emberizidae	*Vermivora pinus* (Linnaeus)	Blue-winged Warbler
	Vermivora peregrina (Wilson)	Tennessee Warbler
	Parula americana (Linnaeus)	Northern Parula Warbler
	Dendroica petechia (Linnaeus)	Yellow Warbler
	Dendroica magnolia (Wilson)	Magnolia Warbler
	Dendroica coronata (Linnaeus)	Yellow-rumped Warbler
	Dendroica virens (Gmelin)	Black-throated Green Warbler
	Dendroica fusca (Muller)	Blackburnian Warbler
	Dendroica castanea (Wilson)	Bay-breasted Warbler
	Dendroica cerulea (Wilson)	Cerulean Warbler
	Mniotilta varia (Linnaeus)	Black-and-white Warbler
	Setophaga ruticilla (Linnaeus)	American Redstart
	Seiurus aurocapillus (Linnaeus)	Ovenbird
	Seiurus noveboracensis (Gmelin)	Northern Waterthrush
	Oporornis philadelphia (Wilson)	Mourning Warbler
	Geothlypis trichas (Linnaeus)	Common Yellowthroat
	Piranga olivacea (Gmelin)	Scarlet Tanager
	Cardinalis cardinalis (Linnaeus)	Northern Cardinal
	Pheucticus ludovicianus (Linnaeus)	Rose-breasted Grosbeak
	Passerina cyanea (Linnaeus)	Indigo Bunting
	Spizella passerina (Bechstein)	Chipping Sparrow
	Melospiza melodia (Wilson)	Song Sparrow
	Agelaius phoeniceus (Linnaeus)	Red-winged Blackbird
	Quiscalus quiscula (Linnaeus)	Common Grackle
	Molothrus ater (Boddaert)	Brown-headed Cowbird
	Icterus galbula (Linnaeus)	Northern Oriole
Fringillidae	*Carpodacus mexicanus* (Muller)	House Finch
	Carduelis tristis (Linnaeus)	American Goldfinch
Passeridae	*Passer domesticus* (Linnaeus)	House Sparrow

Appendix G. Avian breeding densities within forested wetland and upland zones over all study sites (within plot observations only) during the 1998 and 1999 breeding seasons. Migrant and transient densities are followed by the related abbreviation.

	Avian Density (x)[a]			
Common Name	I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Breeder				
Acadian Flycatcher	0.09	0.09	0.11	0.06
American Crow	0.08	0.04	0.11	0.17
American Goldfinch	0.40T	0.20T	0.32T	0.9
American Redstart	0.95	0.56	1.07	0.39
American Robin	0.94	0.88	0.49	0.29
American Woodcock	.	.	.	0.05
Belted Kingfisher	0.01	0.01	0.03	.
Black-capped Chickadee	0.36	0.86	0.83	0.56
Blue-gray Gnatcatcher	0.93	0.39	0.52	0.20
Blue-winged Warbler	.	.	.	0.11
Blue Jay	0.14	0.53	0.51	0.25
Brown-headed Cowbird	0.26	0.22	0.27	0.34
Brown Creeper	0.18	0.59	0.35	0.03
Canada Goose	0.13	0.03	.	0.05T
Cerulean Warbler	0.20	0.28	0.23	0.09
Common Grackle	0.43	0.63	0.38	0.32
Common Yellowthroat	0.08T	0.07T	0.07T	0.44
Downy Woodpecker	0.54	0.68	0.49	0.33
Eastern Phoebe	0.12	0.01	0.00	0.02
Eastern Wood-Pewee	0.24	0.43	0.65	0.14
Gray Catbird	0.07	0.03	0.01	0.61
Great Crested Flycatcher	0.47	0.33	0.42	0.10
Hairy Woodpecker	0.22	0.34	0.19	0.04
Hooded Merganser	0.04	.	.	.
Indigo Bunting	0.18	0.05	0.34	0.22
Least Flycatcher	0.16	0.01	0.02	.
Mallard	0.29	.	.	.
Northern Cardinal	0.40	0.18	0.29	0.53
Northern Flicker	0.03	0.11	0.08	0.04
Northern Oriole	0.62	0.35	0.26	0.22
Northern Rough-winged Swallow	0.06	.	.	.
Ovenbird	0.00T	.	.	0.15
Prothonotary Warbler	0.39	0.17	0.00	.
Red-bellied Woodpecker	0.40	0.46	0.33	0.18
Red-eyed Vireo	0.38	0.47	0.58	0.44
Red-headed Woodpecker	0.03	0.04	.	.
Red-tailed Hawk	.	0.01	0.02	.
Red-winged Blackbird	0.03	0.36	0.09	0.61
Rose-breasted Grosbeak	0.17	0.07	0.18	0.14

Appendix G (cont'd).

Common Name	Avian Density (x)[a] I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Breeder (cont'd)				
Ruby-throated Hummingbird	0.01	0.01	0.02	0.02
Scarlet Tanager	0.13	0.06	0.18	0.08
Song Sparrow	2.13	0.94	1.44	0.7
Tree Swallow	0.16	0.03	.	.
Tufted Titmouse	0.53	0.47	0.63	0.39
Veery	.	0.02	0.02	0.02
Warbling Vireo	0.29	0.03	0.03	.
White-breasted Nuthatch	0.62	0.54	0.59	0.21
Willow Flycatcher	.	.	.	0.06
Wood Duck	0.03	0.07	0.00	.
Wood Thrush	0.03	0.06	0.13	0.41
Yellow-billed Cuckoo	0.07T	0.06T	0.03T	0.06
Yellow-throated Vireo	0.18	0.14	0.10	0.04
Yellow Warbler	0.21	0.11	0.06	0.25
Migrant/Transient				
Alder Flycatcher	.	.	.	0.02
Barn Swallow	0.04T	0.03T	.	.
Bay-breasted Warbler	.	0.01T	.	.
Black-and-white Warbler	0.03T	.	0.05T	.
Black-billed Cuckoo	.	.	.	0.02T
Black-throated Green Warbler	0.01M	.	0.02M	0.02M
Black-throated Blue Warbler	.	.	.	0.02M
Blackburnian Warbler	.	.	0.03M	0.05M
Brown Thrasher	.	.	.	0.03T
Carolina Wren	0.01T	.	0.00T	.
Cedar Waxwing	0.40T	0.10T	0.12T	0.18T
Cooper's Hawk	.	.	.	0.03T
European Starling	.	0.14T	0.03T	.
Field Sparrow	.	.	.	0.02T
Golden-winged Warbler	0.01T	.	.	.
Great Blue Heron	0.01T	0.01T	.	.
House Sparrow	.	.	0.03T	.
House Wren	.	.	.	0.03T
Magnolia Warbler	0.01T	0.01T	.	0.03T
Mourning Dove	0.03T	.	.	0.02T
Mourning Warbler	0.01M	.	0.02M	.
Nashville Warbler	0.06M	0.03M	0.10M	0.03M
Northern Parula Warbler	0.04M	.	.	.
Northern Waterthrush	.	0.01M	.	0.02M
Orange-crowned Warbler	.	.	.	0.02M

Appendix G (cont'd).

Common Name	Avian Density (x)[a] I-Forested Wetland	II-Forested Wetland	III-Forested Wetland	IV-Upland
Migrant/Transient (cont'd)				
Savannah Sparrow	.	.	.	0.02T
Solitary Vireo	.	0.02T	.	.
Spotted Sandpiper	0.01T	.	.	.
Swainson's Thrush	0.06M	.	.	.
Tennessee Warbler	0.03M	0.01M	0.02M	0.02M
Wild Turkey	0.02T	.	.	.
Yellow-rumped Warbler	0.06T	0.03T	0.06T	0.01T

[a]Non-Breeding Density Abbreviations:
M=Regional migrant
T=Regional breeder (confirmed or unconfirmed) , but transient through survey zone
.=Not observed within plot in the survey zone

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