1976

Breeding Birds and Vegetation of the Central Illinois Floodplain Forest

Daniel Edward Varland
Eastern Illinois University

BREEDING BIRDS AND VEGETATION OF THE CENTRAL ILLINOIS FLOODPLAIN FOREST

(TITLE)

BY

DANIEL EDWARD VARLAND

B.S., Eastern Illinois University

1974

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF

Master of Science

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

1976
YEAR

I HEREBY RECOMMEND THIS THESIS BE ACCEPTED AS FULFILLING
THIS PART OF THE GRADUATE DEGREE CITED ABOVE

27 July 1976
DATE

ADVISER

27 July 1976
DATE

DEPARTMENT HEAD

PAPER CERTIFICATE #2

TO: Graduate Degree Candidates who have written formal theses.

SUBJECT: Permission to reproduce theses.

The University Library is receiving a number of requests from other institutions asking permission to reproduce dissertations for inclusion in their library holdings. Although no copyright laws are involved, we feel that professional courtesy demands that permission be obtained from the author before we allow theses to be copied.

Please sign one of the following statements:

Booth Library of Eastern Illinois University has my permission to lend my thesis to a reputable college or university for the purpose of copying it for inclusion in that institution's library or research holdings.

July 29, 1976
Date

Author

I respectfully request Booth Library of Eastern Illinois University not allow my thesis be reproduced because _____

_____

_____

_____
Date

_____
Author

pdm

The undersigned, appointed by the
Head of the Department of Zoology,
have examined a thesis entitled

Breeding Birds and Vegetation of the
Central Illinois Floodplain Forest

Presented by

Daniel E. Varland

a candidate for the degree of
Master of Science, and hereby
certify that in their
opinion it is acceptable.

INTRODUCTION

The floodplain forest, a woodland type often confined to narrow strips of untillable land on either side of a waterway, is frequently disregarded as an important component of our natural environment. This forest community has come under heavy attack in recent years with the channelization and reservoir projects of the U.S. Army Corps of Engineers and Soil Conservation Service (SCS).

Channelization is stream alteration by widening, deepening, and straightening designed to reduce flooding. Trees and shrubs are usually removed on either side of the stream in a width varying from 5 to 50 m (Ferguson et al. [1975]). By 1972, 15,322 km along U.S. streams were channelized by the Soil Conservation Service and Army Corps of Engineers, altering the natural drainage pattern of more than 4,048,583 ha of land (Gillette 1972).

Army Corps of Engineers' lake and reservoir projects dam rivers to reduce flooding and provide water supplies and recreation for the surrounding area. By 1973, 41 reservoirs were complete in 6 midwest states, inundating 148,206 ha (all area sizes given here are water hectares at the average recreational pool) of wildlife habitat (U.S. Dept. Army 1973). State by state, these projects include: Iowa, 3 projects, 10,062 ha; Missouri, 3 projects, 27,777 ha; Illinois, 2 projects, 26,684 ha; Indiana, 6 projects, 8,565 ha; Kentucky, 10 projects, 57,469 ha; and Ohio, 17 projects, 17,649 ha. Water hectares behind locks and dams along navigable

rivers are excluded from the area values given.

With few exceptions, avian floodplain forest studies have concentrated on description of bird species composition and population density while including little about vegetation type (Fawver 1947, Hudson 1968, Zimmerman and Tatschl 1975). Ecological studies of other forest types have included relationships between avian populations and habitat composition (Bond 1957, MacArthur and MacArthur 1961, James 1971, Willson 1974). Illinois floodplain vegetational analyses alone have been conducted by Hosner and Minckler (1960, 1963), Crites and Ebinger (1969), and Bell (1974a, 1974b).

In this study, I shall quantify the association between avian breeding populations and the vegetational substrate in sectors of the floodplain forest of the Embarras River in Illinois. I further intend to compare data from my study sites with those from similar studies of this threatened community type in Illinois and elsewhere along a west to east gradient across the eastern deciduous forest.

METHODS

Description of Study Areas

The Embarras River has its headwaters in Champaign County, Illinois, flows south through east-central Illinois for 259 km, and empties into the Wabash River south of Lawrenceville, Illinois (Crites and Ebinger 1969). Sampling of plant and bird populations was conducted on 5 floodplain forest sites along the river between Charleston Lake and Fox Ridge State Park in Coles County, Illinois (Fig. 1).

Aerial photographs, obtained from the Agricultural Stabilization and Conservation (ASCS) office in Charleston, were used in the determination of area size and enlarged for use as field maps of the forest sites. Area size was determined by placing gridded paper under the photo on a lighted map board and establishing ratios, through a system of dots, between areas of a known size and those of a particular study area.

The sites were selected on the basis of the following criteria: (1) sites must be no less than 8.0 ha (20 acres) in size; (2) they must occupy low ground, without steeply sloping land or high terraces; (3) they must be similar in canopy tree composition and size; (4) they must be free from recent and major man-made disturbances such as extensive logging or agricultural encroachment on land immediately adjacent to the river. All lands adjacent to the forest study sites are either agricultural or other forest types.

Area A- The site, sampled from the east bank, is 1.2 km long, ranges in width from 50 to 61 m, and has an area of 10.3 ha. Two streams join the river, one at the upper end and one midway through the site. The lower extent is bordered by a road for 704 m. Some logging of trees was undertaken prior to sampling on the vegetatively unsampled west bank.

Area B- The site, sampled from the west bank, is 1.4 km long, ranges in width from 20 to 161 m, and has an area of 12.4 ha. The upper part of the site includes 854 m along Kickapoo Creek, while the lower 546 m follows the Embarras River. This lower extent is bordered by a road for 302 m.

Area C- The site, sampled from the west bank, is 1.2 km long, ranges in width from 40 to 221 m, and has an area of 12.4 ha. One stream joins the river midway through the study site.

Area D- The site, sampled from the east bank, is 1.8 km long, ranges in width from 60 to 131 m, and has a area of 15.0 ha. Two streams join the river at the study site, one near the upper third and one near the lower third.

Area E- The site, sampled from the east bank, is 1.2 km long, ranges in width from 40 to 181 km, and has an area of 9.0 ha. Two streams join the river with one serving as an upper boundary and the other nearly bordering the lower extent. Some logging of trees has occurred at the upper end of the vegetatively sampled east bank.

Vegetational Sampling

Approximately 70 hours were spent in vegetational sampling at the 5 sites which was conducted between 16 August and 30 September 1975. Sampling was conducted on one side of the river by the point-centered quarter method of Cottam and Curtis (1956). At each site, the forest was divided into thirds parallel to the river course and sampling points were alternated in each third at 30.5 m (100') intervals. A minimum of 40 points were sampled at each site, with these totals: area A (40), area B (47), area C (44), area D (40), and area E (40).

Vegetation was divided into 3 strata according to the following categories: canopy = woody plants $\geq$1.4 m (4½') high and $\geq$1 dm (4") diameter at breast height (dbh); understory = woody plants $\geq$1.4 m high and $<$ 1 dm dbh; ground cover = all herbaceous plants and any woody plants $<$ 1.4 m high. Dead trees were not sampled.

For canopy and understory plants, each sampling point was quartered

and the species, dbh (canopy species only), and distance from the sampling point to the nearest stem in each quarter was recorded. When no canopy or understory vegetation plants were present in a quarter of a point within 15.2 m (50'), 15.2 m was assigned as the distance between the nearest stem and the sampling point.

Ground cover included the plant species (or genus in many cases) occupying $\geq$ 50 percent of a line from the sampling point to the canopy tree in each quarter. If no canopy tree was present within 15.2 m of the center of a point in a quarter, ground cover was sampled as the plant type occupying $\geq$50 percent of a 7.6 m (25') line bisecting the quarter of that point.

Bare ground, recorded when $\geq$75 percent of the quarter of each sampling point was devoid of ground cover vegetation, is reported as a relative frequency value (number of sampling points of occurrence of bare ground divided by the total number of sampling points of occurrence of all plant species and bare ground). Numbers entering into the calculation of relative frequency for bare ground do not enter into the calculation of relative frequency for ground cover plants.

The importance value (IV), used to determine the vegetational importance of canopy tree species within and between areas, was calculated according to the procedures of Curtis and McIntosh (1951), in which the IV for each species at a particular area is the sum of its relative frequency (RF),

$$\frac{\text{number of sampling points of occurrence of a species}}{\text{total sampling points of occurrence of all species}} \times 100$$

relative density (RD),

$$\frac{\text{number of individuals of a species}}{\text{total number of individuals of all species}} \times 100$$

and relative dominance

$$\frac{\text{basal area of a species}}{\text{total basal area of all species}} \times 100$$

In understory and ground cover strata no relative dominance measurements were taken and IV is replaced by the "RF + RD Index", representing the sum of relative frequency and relative density values for each species at an area. Because of only slight differences in these values, relative frequency and density values are not given in tables concerning understory and ground cover strata.

L. B. Hunt advised on the vegetation procedures and aided in plant identifications. J. E. Ebinger assisted in plant identifications and provided pertinent literature. Jones (1963) was used for botanical nomenclature. Scientific names are confined to the appendices for convenience.

Bird Population Measurements

Avian population densities were censused on each of the 5 sites 9 times between 14 April and 30 June 1975. Usually 2 hours were spent afield, totaling over 100 hours of field observation. All avian censusing was conducted from routes on one side of the river, introducing potential bias favoring populations on the sampled side.

Breeding-bird populations were determined using the spot-map method of Williams (1936), where location and movements of birds were recorded on scale maps of each area. The data were later transferred to separate maps for each species. Clumping of records for a bird at a specific location on no less than two-thirds of the visits beginning with the first

observation of that bird (many migratory birds arrived after 14 April) on a site indicated a territory or nesting pair. Birds active on both sides of a study site border were recorded as half-pairs.

Where birds are recorded as visitors on some sites (observed less than two-thirds of trips) the symbol + is used while the symbol 0 denotes birds never encountered on a site. Birds flying overhead without indication of territory were excluded. Brown-headed cowbirds, parasitic on other birds and hence without a definitive territory (Bent 1958), were present on all 5 sites but completely excluded from the paper. Avian densities in all tables are shown as pairs per 40 ha (100 acres).

The bird species diversity (H') index is that of Shannon and Weaver (1949) and is given in units based on natural logarithms computed from the tables of Lloyd et al. (1968). Equitability (J') is calculated by the formula of Pielou (1966).

Two 23.7 km (14.7 mi) canoe trips were taken on 21 June and 27 June 1975 with L. B. Hunt down the Embarras River from Charleston Lake to Ryan's bridge in northern Cumberland County. The purpose of the trips, including areas A through E at a total distance of about 3.5 times their combined length, was to provide an extensive avian survey for a basis of comparison with the intensively surveyed study sites. Both trips began at 6:30 a.m., with the first lasting 5 hours and the second 4 hours and 47 minutes. Male birds seen or heard and thought to be associated with the floodplain forest were recorded at half-hour intervals and later converted to birds per kilometer.

L. B. Hunt advised on the procedures and aided in initial bird song identification necessary for this study. Ornithological nomenclature

follows the A. O. U. (1957) checklist with revisions. Scientific names are confined to the appendix as a matter of convenience. Except for no capitalization of bird or plant names, format and procedures of the Wilson Bulletin were used in writing this paper.

RESULTS

Vegetation

The floodplain forest has a distinct vegetational pattern. In the canopy layer, a total of 21 species were identified, with 34 in the woody understory and 19 in the ground cover (figure includes many identified to genus only). Area E, however, does deviate from the pattern of the other 4 sites. Hence, E data will be excluded from the calculation of mean values and discussed separately for most plant and bird populations considered.

Canopy trees.--The trees in this category represent the highest potential avian nesting stratum in the floodplain forest community. A wide range of tree densities exists among the 5 sites (Table 1). Area B has the lowest density with 216.4 trees per ha while D has the highest density with nearly twice that of B. Areas A and E have similar densities, with both subject to logging but on the vegetatively unsampled side of A.

Most of the canopy vegetation is composed of relatively few species. Of the 21 species found on the 5 sites, only 8 are common to all sites, making up 92.2 percent of the total importance value for the 5 sites.

The importance value (IV), a composite measure of the distribution, numbers and size of a tree species within an area, provides an objective

index to the degree of influence or control exerted by each species within that area. Silver maple and box elder are the dominant species on sites A through D, making up 58.0 percent of the total importance value on these areas. Silver maple alone contributes more than one-third of the total IV at A through D because of its great density and large trunk size, while box elder ranks second in overall importance due to similar relative frequency and density but with much smaller average trunk size. Hackberry, sycamore, and cottonwood follow as canopy dominants but vary in rank from site to site. Large trunk size in a few individuals results in a high position for sycamore. This is especially evident at area B where the presence of one large tree on the study area caused a high relative dominance value.

Other species found on all 5 sites to be regarded as regular members of the floodplain forest community are slippery elm, black walnut, and green ash. Slippery elm, like box elder, has a small overall trunk size as indicated by low relative dominance values on each site. Additional species present contribute little to forest dynamics but might be attractive to one or more avian species.

The obvious difference between area E and the other sites is the replacement of silver maple by hackberry as the number one ranked tree. Hackberry ranks first with a much lower IV than does silver maple on the other sites, indicating a lesser degree of domination by any one species. Sharing a second order of importance are slippery elm, silver maple, and box elder followed by green ash and black walnut. The latter two species have similar ranks on all 5 sites but exhibit appreciably higher importance values on this last site. Cottonwood, as a regular dominant in

the floodplain forest elsewhere, ranks last among 16 species listed for area E.

Understory vegetation.--The understory vegetation serves as the middle stratum for potential avian nesting. The density of the understory flora is greater than in the canopy layer, with only area B having a density similar to any canopy figures (Table 2). Area E has a density of over 4 times that of B, with 1272 stems per ha.

In the understory, the 9 species common to all 5 sites make up 85.9 percent of the total RF + RD Index. A greater number of species are represented in the understory than in the canopy, but most of these species were rarely encountered and are included in the "others" category. The close similarity in relative frequency and density values for most understory species demonstrates the random distribution of individuals throughout the forest.

Box elder, ranking second in the canopy, ranks first in overall importance in the understory. Grape ranks second on areas A through D except B, where silver maple is second, but the latter ranks much lower in the understory of the other sites. Area B, differing somewhat in the typical understory vegetation, is lacking in vine-like plants as evidenced by low index values for grape, poison-ivy, and greenbrier.

At E, grape replaces a low-ranked box elder as the understory dominant. Hackberry ranks second in the understory, reflecting good reproduction of the canopy dominant for this site. Grape and poison-ivy at E are the only 2 plant types which have dissimilar relative frequency and density values. Grape has a relative frequency of 18.8 and a relative density of 27.0 (not given in the Table 2), reflecting the presence of

pockets of dense vines throughout the site. Poison-ivy has a relative frequency of 11.9 and density of 3.6, reflecting more scattered distribution of this plant type.

Ground cover.--Ground cover is the lowest floral stratum available for avian nesting. As in the understory vegetation, relative frequency and density values are combined to yield the RF + RD Index (Table 3). The 4 plant types (many identified to genus only) common to the 5 sites comprise 80.9 percent of the total index value. Grasses are clearly dominant on all areas with measurements of individual species not taken. Nettle, aster, and poison-ivy follow as important components of the ground cover vegetation. Sites B and E differ from the other areas where poison-ivy replaces nettle as the second-ranked ground cover plant. Percent bare ground, measured as a relative frequency value, is similar on A, B, and C while sites D and E have comparatively smaller values.

BREEDING-BIRD POPULATIONS

Study area censuses.--Of the 41 species represented in the breeding-bird census, 17 are represented by at least one pair on each site, making up 70.9 percent of the total nesting population (Table 4). The breeding-bird species are arranged in order of decreasing density as determined by the mean number of nesting pairs for each species at areas A through D, and all are reported as pairs per 40 ha (100 acres).

Area A has the greatest number of species with 35, while D is second with 32. Areas B, C, and E have similar but smaller species numbers. Species number alone, however, is not an adequate measure because

it is influenced by the size of an area and it gives every species of that area equal consideration when some may be more important (because of large numbers) than others.

Another measure, bird species diversity (H'), is more useful because it is a function of species richness (number of species) and the distribution of individuals among each species, or equitability (J') (Tramer 1969, Kricher 1972, Uetz 1974). Equitability (J'), which has high values in my study (Table 4) when compared with other habitat types (Kricher 1972), may be calculated apart from species diversity (H'). When the equitability value within a population reaches its maximum of 1.00, each species of that population on a site has the same number of individuals (ie. 5 indigo buntings, 5 house wrens, etc). Species diversity (H') is highest when species richness is high and there is an even distribution of individuals among the species. This relationship is apparent where site A, with the highest species diversity, has the largest species richness (35) and equitability values; area C, with the lowest species diversity, has the lowest species richness and equitability values. The differences in species diversity and equitability from site to site are relatively minor, reflecting uniformity in species density and distribution within this community type.

Area A has the highest density of breeding pairs with 310, while E follows closely with 297 pairs, and the other three have smaller but similar densities. While A and E have the largest total breeding populations, they are also the smallest in area; there is a tendency for areas of smaller size to appear to have populations of greater density because more individuals with territories partially in the study area

are counted as nesters than in larger study areas.

Floodplain forest has extensive forest edge with the presence of: area along the river where river and forest meet, many fields adjacent to the forest, and open areas in the canopy layer. Johnston (1947) determined the forest edge to be a unique community type based on its inhabitation by avian species different from forest interior and open field. Kendeigh (1944;1974) suggests and later demonstrated in breeding-bird censuses of Trelease Woods in central Illinois that avian forest-edge populations be expressed on a linear basis as pairs per km. Based on the classifications of Kendeigh (1944), Johnston (1947), and Bent (1919-1968), 51.2 percent of the total species and 49.5 percent of the mean population density in study areas A through D are forest edge (E) nesters, with forest interior (I) nesters making up the remaining percentages.

The avian species can also be subgrouped by nest-site preferences based on the preferred nesting stratum categories of Bond (1957) and Bent (1919-1968). Using this system, 19.5 percent of the species and 18.0 percent of the mean population density (on areas A through D) are high open nesters (HO), 48.8 percent of the species and 45.6 percent of the mean population density are low open nesters (LO), and 31.7 percent of the species and 36.4 percent of the mean population density are hole nesters (HN).

Birds with high mean densities on areas A - D (Table 4) can be considered characteristic of the central Illinois floodplain forest whereas those occurring in low numbers are either uncommon to this region or prefer other habitat types. Some species occur in high mean densities

as a result of large numbers on one or a few sites. Area A has 12 species found in densities at least twice that of all sites except E while B has 4 such species, C has none, and D has two.

Area E, dissimilar in vegetational composition, also has avian species present in especially high densities. The indigo bunting, Acadian flycatcher, cardinal, and song sparrow are found in densities significantly greater than on A - D. The site also has high densities of warbling vireo and American redstart in common with area A. The red-headed woodpecker ranks third in density on the other sites and is found in low densities at E.

River censuses.--A total of 61 species were recorded on the 2 trips with 59 on trip 1 and 57 on trip 2 (Table 5). Species were recorded as birds observed per half-hour interval and later converted to birds heard per km. In each trip, all species have a wide range of high and low density per interval while between trips 1 and 2 the mean density for almost every species is comparable. Only the northern oriole, mourning dove, and American redstart have mean densities on one trip at least.

To compare the results of the river censuses with those for the field studies, the mean breeding-bird density for avian species on areas A through D and the combined mean density for species on the river censuses are expressed in terms of relative density (Table 6). For instance, the mean number of breeding pairs of indigo buntings on sites A - D (21.8) is divided by the total mean avian density (230.0) to yield a percentage 9.5. For this species in the river censuses, 3.8 is divided by 32.8 (the number representing river census birds common to both census types and

not shown in Table 5), thus giving a relative density of 11.6. The table is limited both to those species common to river and field censuses and to those with relative densities of one percent or greater on either mean census.

Of the top 11 species on the river censuses, 9 are among the top 11 on the study sites but only the indigo bunting occupies the same rank. Ten avian species have relative densities at least one and one-half times higher on the field sites than the river censuses (A) while 9 are higher by this value in the river censuses (B) (Table 6). All other species (18 of the total 37 species) have densities between these high and low values and hence are comparable.

Wood ducks with broods were observed on both the site and river censuses. In the site studies, 3 breeding pairs of wood ducks were recorded with 2 broods of 5 and 7 chicks. On the first river census, 1 of 2 females sighted had a brood of 7 chicks while on the second trip, 3 females and 3 broods were recorded with 1, 6, and 8 chicks.

DISCUSSION

Site studies.--In floodplain forest sites A through D, the importance values of the 2 canopy dominants dictate a silver maple-box elder community, while understory distribution of these species indicates their continued importance. Other secondary dominants also significant in the understory are hackberry and slippery elm, but sycamore and cottonwood saplings are scarce or missing.

Crites and Ebinger (1969), in an intensive floodplain vegetation

survey of the "first bottoms" (Putnam 1951) along the Embarras River in Coles County, Illinois, found vegetational results similar to mine with silver maple, cottonwood, box elder, and black willow being most important, while understory seedlings and saplings tended toward increasing dominance by silver maple and box elder. Any difference in results between my study and theirs are probably due to varied sampling techniques (point-centered quarter method versus quadrat method) and my inclusion of the area beyond the "first bottoms".

Area E has a vegetation pattern different from the other sites (Table 7) because it is located at higher elevation. Bell (1974a), in a survey of the Sangamon River in Piatt County, Illinois, found canopy vegetation distinctly dominated by silver maple in areas of bottomland experiencing greater than 5 percent flooding. In areas of slightly higher elevation, or about 3 percent flooding, vegetation dominance changed from silver maple to hackberry and shingle oak, accompanied by an increased number of canopy tree species.

In my study, area E shows these characteristics with the domination of hackberry in the canopy and a large number of species represented in both the canopy and understory strata (Tables 1 and 2). Further evidence is shown in percent bare ground figures for the site. Bare ground in bottomland floodplain forest is primarily the result of the scouring effect of frequent flooding and the denuding of vegetation by standing water (Fawver 1947, Lindsey et al. 1961). This percentage is lowest at E (Table 7), indicating an area at higher elevation subject to less flooding.

Scouring by flood waters may also inhibit the development of other

vegetational strata (Lindsey et al. 1961). Hosner and Minckler (1963) have stated that bottomland deciduous forest progresses to a sub-climax forest until long-term, gradual aggradation from flooding has occurred. The understory vegetation at E is over twice the mean density of the other 4 sites, probably in part due to the lack of flood-caused vegetation destruction. Also, the smaller density of the tree canopy at E may have helped understory development by providing extra area for vegetation growth and necessary light penetration.

Grasses require large amounts of sunlight for growth and development as evidence by their early seral position in secondary succession (Johnston and Odum 1956). A forest with grasses as the dominant herb probably indicates good sunlight penetration to the forest floor. Sunlight penetration at my floodplain forest sites could result at areas of open canopy or forest edge, which is prevalent in this characteristically long and narrow forest type. Area B has the smallest tree canopy density and the largest RF and RD Index value for grasses. Lindsay et al. (1961) noted the abundance of sunlight (which might also enhance the development of the understory stratum) in an Indiana floodplain forest.

Area E also has less forest interior than the other sites. With the total length of E (1.2 km) nearly equal to that of the mean of A through D (1.4 km), its area size is 3½ ha smaller than the mean of the other sites (Table 7). Hence, E is composed of narrower strips of floodplain forest.

Different from the other sites in vegetational composition and available forest, E also differs in its breeding-bird population (Table 7). With a greater density of understory vegetation, 58.1 percent of the

avian population at E included in Table 7 are low open nesters while 45.0 percent occur in this category for A through D. Narrower strips of forest at E create less available forest interior at this site resulting in greater densities of some forest-edge nesting species.

The indigo bunting, over 1½ times more abundant at E, is a forest edge-understory nesting species. The territory of this bird was most often located at the outside edge of the forest, adjacent to agricultural land. Other indigo bunting territories occurred in openings of the forest canopy and the forest edge adjacent to the river. Bond (1957), in deciduous forest stands of southern Wisconsin, found this species 5 times more common in open xeric forest than in his most mesic forest stands.

The cardinal, another species in high density at E, most often utilized forest edge understory adjacent to the river. Fawver (1947), in a study of breeding-birds along the Sangamon River, found 6 of 9 nesting cardinals in forest-edge shrub next to the stream.

The song sparrow in another forest edge-understory nesting species in highest density at E. In a comparative study of bird populations throughout Illinois (Graber and Graber 1963), northern Illinois song sparrow densities yielded 95.9 pairs per 40 ha in edge shrubs and 1.7 pairs per 40 ha in deciduous forest.

Shrub-nesting species of the forest interior in higher density at E are the Acadian flycatcher and American redstart. These species prefer areas of dense understory, which are most predominant at E (Fawver 1947, Karr 1968).

The red-headed woodpecker is the only species found with a much

higher mean density (3½ times) at sites A through D. This species prefers areas of limited understory (Bent 1939) more characteristic of these sites. Large increases in the density of the red-headed woodpecker (1927-1955: 2.2 mean pairs per 40 ha; 1956-1966: 26.2 mean pairs per 40 ha) determined from breeding-bird censuses of another central Illinois floodplain forest were attributed to Dutch elm disease and the resulting creation of open areas and dead trees for nest sites (Hudson 1968).

Some bird species, by their higher densities, show a preference for some study area other than E. High nesting density of a species at a particular site is probably the result of unique vegetation characteristics which especially attract that species. While vegetational configuration is more important than plant species composition in determining avian nesting preferences (MacArthur and MacArthur 1961, James 1971), Bond (1957) points out that tree species have different forms and arrangements of leaves, branches, and twigs serving to attract certain bird species.

The common yellowthroat is common to all sites but in greatest density at area B (Table 4). This species prefers bush habitat adjacent to streams (Bent 1953), and commonly nests in grass-shrub mixtures (Johnston and Odum 1956). Higher densities of common yellowthroat at area B may be accounted for by a higher RF and RD Index value (91.7 percent) for grasses at this site (Table 3), a plant type which this species prefers for nesting.

The warbling vireo, observed on all sites singing at the forest edge adjacent to the river, prefers forest areas which are open with scattered trees (James 1976). This species was found in greatest densities

at sites A and E which have similar and smaller canopy tree densities than all but one other site (Table 1).

Sycamore has a high IV rank at areas A, C, and E, and certain avian species attracted to this tree type are also in greater densities at some of these sites. The yellow-throated warbler (once called the sycamore warbler) was most often observed in sycamore trees and is in highest density at A, where this tree species has its highest IV. The live sycamore contains many holes and hence is available for cavity nesting birds. The starling is a cavity nester found in highest densities at A. The wood duck is another cavity nester, nesting at A, C, and D.

While some avian species appear in higher density on one or a few sites, the tufted titmouse and eastern wood pewee are the only birds of the top 26 species (Table 4) in nearly equal densities on all 5 sites. Bond (1957), in a study of breeding-birds from pioneer to climax forest in southern Wisconsin, found the eastern wood pewee a common nester in all habitats. Consequently, this species might be found in even density on my 5 sites as a result of being unbiquitous, or able to exist in a wide variety of habitat or vegetation types.

Increased vegetational complexity through progressive seral stages characteristic of secondary succession toward a climax upland deciduous forest yields a total avian density, species diversity (H'), and equitability (J') which increases steadily to a peak in the shrubby stage, followed by a decline in the climax community (MacArthur and MacArthur 1961, MacArthur et al. 1966, Roth 1967, Karr 1968, Hudson 1968, Shugart and James 1973). Karr (1968) explains this peak in the shrub community as the result of a complex vegetation structure made up of the

inter-mixing of grassland, shrubs, and trees. Increasing canopy shade with progression toward the climax community in upland forest results in a reduction of the shrub and ground cover layers (Hudson 1968).

In a study of avian diversity and density in the Virginia Piedmont, Ferguson et al. [1975] found both to increase in relation to the number of years since the completion of channelization. Bird species diversity was 1.748 on the 2-year-old site, 2.025 on the 5-year-old site, and 2.342 on the 9-year-old site while population density increased respectively from 240 to 360 to 520 birds per 40 ha. These steady increases in diversity and density were attributed to increased vegetational complexity characteristic of secondary succession.

Progressive seral stage succession toward a sub-climax floodplain forest community (Hosner and Minckler 1963) yields an increasing bird species diversity which peaks in the final seral stage (Karr 1968, Zimmerman and Tatschl 1975). This peak is probably the result of the floodplain forests' sub-climax state, which causes maintenance of well developed ground cover and understory strata. On my forest sites A through D (with a mean understory density over 1½ times that of the canopy), the mean bird species diversity is 3.182 while avian diversity is 2.767 for an upland deciduous forest in central Illinois and 2.739 for a climax oak-hickory forest in Georgia (Roth 1967).

Equitability (J'); the distribution of individuals among the species, follows the same pattern of increase throughout secondary succession as does avian diversity (Tramer 1969, Kricher 1972, Zimmerman and Tatschl 1975). High equitability values in later seral stages are the result of an abundance and even distribution of nesting birds of

the same species, each with its own definitive territory (Kricher 1972).

High values for avian density, diversity (H'), and equitability (J') in my floodplain forest sites in comparison with other habitat types indicate a habitat where many more bird species and individuals are present, and competition between nesting species is reduced. Intraspecific competition acts to lower avian diversity by causing unequal and smaller numbers of each species to be present in a population (Roth 1968). Karr (1968) has suggested that water may act as an additional stratum in attracting certain avian species. The prothonotary warbler, a species nesting on areas A, D, and E occurred in a nesting territory near the river's edge.

With a well developed understory stratum on all sites, the greatest percentage of the breeding-birds on areas A - D are low open nesters (45.6 percent), but with no ground nesters. Fawver (1947) found similar results using slightly different categories in another central Illinois floodplain forest with 16.4 percent of the total breeding-bird population tree canopy nesters, 47.2 percent shrub nesters, 35.1 percent tree cavity nesters, and 1.3 percent ground nesters compared to 10.1 percent ground nesters in an upland forest. Although frequent flooding will destroy ground nests, it results in dying trees favorable to cavity nesters, while low percentages of canopy nesters are thought by Fawver (1947) to be due to the patchy nature and small size of the canopy. Bond (1957) suggests that canopy openess may serve to attract certain avian species.

With an almost equally divided percentage of the total population density on A through D forest edge (49.5 percent) versus forest interior

(50.5 percent) nesters, my floodplain forest community must possess characteristics of both habitat types. Consequently, avian species attracted to either of these habitats are found.

River Censuses.--The river censuses were conducted to compare an extensive length of floodplain forest with smaller, more intensively studied sectors of the same habitat. Moreover, the 2 census techniques can be compared as to whether one or the other yields more accurate information about breeding-bird populations of this community type.

All species have a wide range of high and low densities in each trip (Table 5) as a result of being observed in varied numbers along certain portions of the river course. Comparative mean densities between trips 1 and 2 for almost all species reflect the consistency with which each species is found as part of the floodplain forest. The common grackle is one of the species found in varied mean density between trips 1 and 2. This may be the result of the gregarious nature of this species, often seen frequenting the river to feed and drink in flocks late in its breeding season.

With 18 of 37 species (48.6 percent) found in comparable relative densities (Table 6), similarities between riparian bird populations of long and short sectors of this habitat are evident. The indigo bunting ranks a similar first in relative density for both study area and river censuses, while other species such as the Acadian flycatcher and cardinal also occur in comparatively high relative densities. The gray catbird and white-breasted nuthatch are two species occurring in similarly low relative densities for both census types but nevertheless may be important members of this community.

Some species may appear in higher relative densities on the study areas because of being more conspicuous. Detection of birds on the river censuses was based almost totally on song from the confines of a canoe whereas birds on the field areas were located on land by both song and sight. The American robin, often beginning its song before sunrise (Leopold and Eynon 1963), was observed in much greater relative densities on the field sites. When both river trips began over an hour after sunrise, this species may have completed its song, thus going unnoticed. The red-headed woodpecker, downy woodpecker, red-bellied woodpecker, and starling, all species which sang at irregular intervals, were found in higher relative densities on the study sites where chances of detection were better. In addition, early nesting species, such as the latter 4 mentioned (Bent 1939, Bent 1950), may have been less evident on the river censuses because of the late dates of these trips.

Sections of marginal habitat included on the river censuses and intentionally excluded from the study sites probably account for other differences in relative density between censuses. Greater densities of some forest-edge birds, such as the song sparrow and American goldfinch, are found on the river censuses where agricultural land adjacent to the river and shrub habitat were more likely to be included.

Differences in relative densities between censuses may be due to differences in sampling techniques or reflect true variations in the population. The intensively censused field sites, which gave the opportunity for closer observation of birds and careful regulation of habitat type, seem to give more information on the true breeding-bird population of the floodplain forest whereas the river censuses provide

a useful, more readily obtainable, but more general account of the birds associated with this community.

Central Illinois Comparisons.--The central Illinois floodplain-forest studies used for comparison with mine (Table 8) were conducted by graduate students at the University of Illinois. Hudson's (1968) study, comparing a floodplain forest with a forest edge, was conducted at Allerton Park in Piatt County, while Karr (1968) studied breeding-bird populations in relation to secondary succession on abandoned strip-mined areas in a near Kickapoo State Park in Vermillion County.

Bird species diversity (H') and equitability (J') are nearly equal in all 3 studies, reflecting uniformity in species richness and the distribution of individuals among the species in this habitat type. The greater nesting density found in Vermillion County may be the result of proportionately larger populations on small areas.

Of the 17 species in highest mean density on my sites A through E in Coles County, 15 occur among the first 17 in Piatt County with 14 of 17 in Vermillion County, demonstrating that many birds in abundance in Coles County are at least part of the floodplain forest community elsewhere in Illinois. The Acadian flycatcher is the only species present on all 3 sites with differences in density of less than 1½ times among the sites. While the indigo bunting ranks first in mean density on my sites in Coles County, its top position is replaced by the American redstart in Piatt County and by the American redstart and starling in Vermillion County. Through the years, the American redstart has repeatedly occurred in high densities in riparian censuses of Allerton Park in Piatt County, Illinois (Hudson 1968).

Among the species in densities high enough to be listed (Table 8), the cerulean warbler and hairy woodpecker are absent only in Coles County, 8 are absent only in Piatt County, and 5 are absent only in Vermillion County. The hairy woodpecker, in addition to the orchard oriole and ruby-throated hummingbird, are species which might have nested on my study areas but went undetected because I did not know their calls. This type of census error, along with location and vegetation differences, could account for some of the missing species in the other 2 studies.

The song sparrow and eastern kingbird are the only species present on my study areas while absent on the other 2. The song sparrow, ranking fourth in mean density on my sites A through E, used areas of well developed sweet clover outside the floodplain forest in Karr's (1968) study and was strangely absent from Hudson's (1968) forest edge site, a habitat often considered part of this species' nesting territory (Bent 1968) and one which contributed most to its occurrence on my sites.

Regional Comparisons.--The floodplain forest studies used for the regional comparison (Table 9) were conducted in Kansas (Zimmerman and Tatschl 1975) as part of a breeding-bird census of 5 floodplain habitats, and in Maryland (Criswell et al. 1973). While the Atlantic Ocean provides a natural barrier to birds in Maryland, the Kansas study is significant in that it occurs near the western border of the ranges of many species characteristic of the eastern deciduous forest. Species are listed in descending order according to those: common to all 3 censuses, from Kansas only, from Kansas and Illinois, from Illinois only, from Illinois and Maryland, and from Maryland only.

Zimmerman and Tatschl (1975), in making the same geographic

comparison using Karr's (1968) study in place of mine, noted a general decrease in total breeding-bird density from east to west. The mean breeding-bird density on my Areas A - E does not support this observation. Some species do decline sharply in total density from east to west and include the Acadian flycatcher, starling, American redstart, Carolina chickadee, prothonotary warbler, and wood duck, with the latter 4 present in Maryland and Illinois only. The high total breeding-bird density in the Maryland study may be the result of the site's small area (7.6 ha) rather than its geographic location, but in another breeding-bird census of the Maryland floodplain forest (Robbins 1974), 18.4 ha in size, a similarly large density (457 pairs per 40 ha) was obtained.

While total breeding-bird density is highest in Maryland, bird species diversity (H') and equitability (J') figures at this site are lower than those similar values in Illinois and Kansas. Low avian diversity and equitability in Maryland reflect a smaller species richness (21) and a more variable distribution of individuals among the species.

Of the top 17 species in highest mean density on my sites A - E in Illinois, 12 occur among the first 17 in Kansas with 11 of 17 in Maryland. There is no species present on all 3 sites, however, in similar density (differences in density of less that 1½ times among the sites). While the indigo bunting is first in mean density in Illinois, this species occurs in medium density in Kansas and is absent in Maryland. In Kansas the cardinal ranks first in density while the starling holds this position in Maryland.

LITERATURE CITED

American Ornithologist's Union. 1957. Check-list of North American birds, 5th ed. Lord Baltimore Press, Baltimore.

Bell, D. T. 1974a. Tree stratum composition and distribution in streamside forest. Amer. Midl. Natur. 92: 35-46.

_____. 1974b. Studies on the ecology of a streamside forest: tree stratum composition and distribution in the streamside forest. Bull. Torrey Bot. Club 101: 14-20.

Bent, A. C. 1919-1968. Life histories of North American (birds). U.S. Nat. Mus. Bulls.

_____. 1939. Life histories of North American woodpeckers. U.S. Nat. Mus. Bull. 174.

_____. 1950. Life histories of North American wagtails, shrikes, vireos, and their allies. U.S. Nat. Mus. Bull. 197.

_____. 1953. Life histories of North American wood warblers. U.S. Nat. Mus. Bull. 203.

_____. 1958. Life histories of North American blackbirds, orioles, tanagers, and allies. U.S. Nat. Mus. Bull. 211.

_____. 1968. Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies. U.S. Nat. Mus. Bull. 237.

Bond, R. R. 1957. Ecological distribution of breeding birds in the upland forests of southern Wisconsin. Ecol. Monogr. 27: 1017-1029.

Cottam, G. and J. T. Curtis. 1956. The use of distance measure in phytosociological sampling. Ecology 37: 451-460.

Criswell, J. H., W. H. Cramer, and C. E. Craven. 1973. Breeding-bird census 13. Mature deciduous floodplain forest. Am. Birds 27: 964-965.

Crites, R. W. and J. E. Ebinger. 1969. Vegetation survey of floodplain forests in east-central Illinois. Trans. Ill. St. Acad. Sci. 62: 316-330.

Curtis, J. T. and R. P. McIntosh. 1951. An upland forest continuum in the prairie-forest border region of Wisconsin. Ecology 32: 476-496.

Fawver, B. J. 1947. Bird populations of an Illinois floodplain forest. Trans. Ill. St. Acad. Sci. 40: 178-189.

Ferguson, H. L., R. W. Ellis, and J. B. Whelan. [1975]. Effects of stream channelization on avian diversity and density in Piedmont Virginia. Unpub. Manuscript.

Gillette, R. 1972. Stream channelization: conflict between ditchers, conservationists. Science 176: 890-894.

Graber, R. R. and J. W. Graber. 1963. A comparative study of bird populations in Illinois, 1906-1909 and 1956-1958. Ill. Nat. Hist. Surv. Bull. 28: 383-528.

Hosner, J. F. and L. S. Minckler. 1960. Hardwood reproduction in the riverbottoms of southern Illinois. Forest Sci. 6: 67-77.

_____. 1963. Bottomland hardwood forests of southern Illinois - regeneration and succession. Ecology 44: 29-41.

Hudson, J. E. 1968. Breeding birds of forest edge and floodplain forest areas in central Illinois. M. S. thesis, Univ. of Illinois.

James, F. C. 1971. Ordinations of habitat relationships among birds. Wilson Bull. 83: 215-236.

James, R. D. 1976. Foraging behavior and habitat selection of three species of vireos in southern Ontario. Wilson Bull. 88: 62-75.

Johnston, D. W. and E. P. Odum. 1956. Breeding bird populations in relation to plant succession in the Piedmont of Georgia. Ecology 37: 50-62.

Johnston, V. R. 1947. Breeding birds of the forest edge in Illinois. Condor 49: 45-53.

Jones, B. N. 1963. Flora of Illinois. 3rd ed. Am. Midl. Nat. Monogr. 7.

Karr, J. R. 1968. Habitat and avian diversity on strip-mined land in east-central Illinois. Condor 70: 348-357.

Kendeigh, S. C. 1944. Measurement of bird populations. Ecol. Monogr. 14: 67-106.

_____, and J. M. Edgington. 1974. Breeding-bird census 38. Oak-maple forest and edge. Am. Birds 28: 1006-1007.

Kricher, J. C. 1972. Bird species diversity: the effects of species richness and equitability on the diversity index. Ecology 53: 278-282.

Leopold, A. and A. Eynon. 1961. Avian daybreak and evening song in relation to time and light intensity. Condor 63: 269-293.

Lindsey, A., R. Petty, D. Sterling, and W. VanAsdall. 1961. Vegetation and environment along the Wabash and Tippecanoe Rivers. Ecol. Monogr. 31: 105-156.

Lloyd, M., J. H. Zar, and J. R. Karr. 1968. On the calculation of information-theoretical measures of diversity. Amer. Midl. Natur. 79: 257-272.

MacArthur, R. H. and J. M. MacArthur. 1961. On bird species diversity. Ecology 42: 594-598.

_____, H. Recher, and M. Cody. 1966. On the relation between habitat selection and species diversity. Am. Nat. 100: 319-332.

Pielou, E. C. 1966. The measurement of diversity in different types of biological collections. J. Theor. Biol. 13: 131-144.

Putnam, J. A. 1951. Management of bottomland hardwoods. Southern Forest Expt. Sta. Occas. Paper 116: 11+60pp.

Robbins, C. S. 1974. Breeding bird census 20. Hickory-oak-ash flood-plain forest. Am. Birds 28: 998.

Roth, R. R. 1967. An analysis of avian succession on upland sites in Illinois. M. S. thesis, Univ. of Illinois.

Shannon, C. E., and W. Weaver. 1949. The mathematical theory of communication. Univ. Illinois Press, Urbana.

Shugart, H. H. and D. James. 1973. Ecological succession of breeding bird populations in northwestern Arkansas. Auk 90: 62-77.

Tramer, E. J. 1969. Bird species diversity: components of Shannon's formula. Ecology 50: 927-929.

Uetz, G. 1974. Species diversity: a review. The Biologist 56: 111-129.

U.S. Dept. Army Corps Eng. 1973. Recreational statistics. U.S. Govt. Printing Office, Washington, D. C.

Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. Ecol. Monogr. 6: 317-408.

Willson, M. F. 1974. Avian community organization and habitat structure. Ecology 55: 1017-1029.

Zimmerman, J. L. and J. L. Tatschl. 1975. Floodplain birds of Weston Bend, Missouri River. Wilson Bull. 87: 196-206.

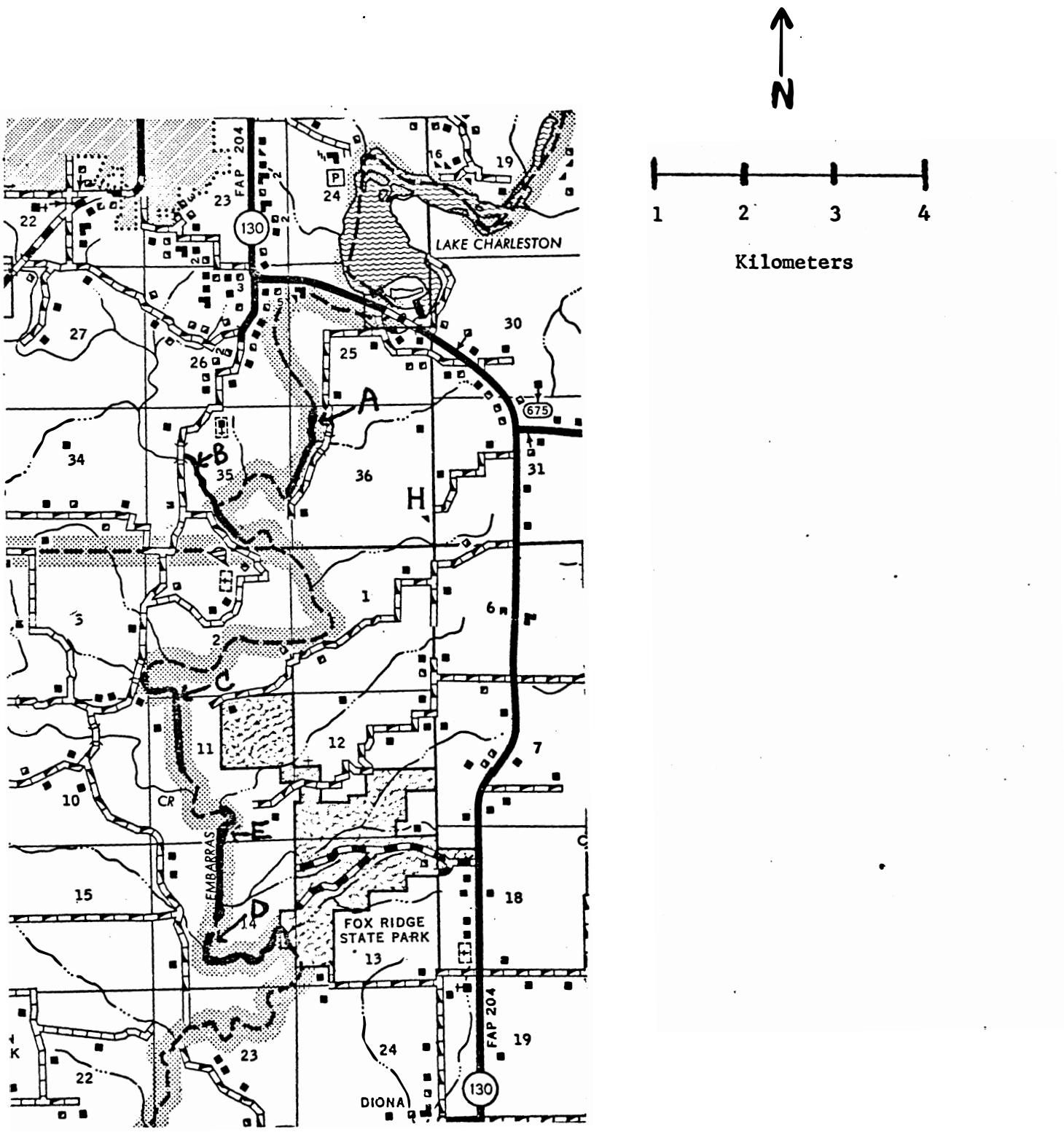

Figure 1. The location of 5 floodplain forest sites in Coles County Illinois, designated A through E.

TABLE 1

Canopy Trees on 5 Floodplain Forest Sites in Central Illinois Ranked in Descending Order of Mean IV for Sites A Through D.

Species	A 304.5 trees/ha					B 216.4 trees/ha					C 410.0 trees/ha					D 430.5 trees/ha					E 314.3 trees/ha				
	Relative Frequency	Relative Density	Relative Dominance	IV	IV Rank	Relative Frequency	Relative Density	Relative Dominance	IV	IV Rank	Relative Frequency	Relative Density	Relative Dominance	IV	IV Rank	Relative Frequency	Relative Density	Relative Dominance	IV	IV Rank	Relative Frequency	Relative Density	Relative Dominance	IV	IV Rank
Silver maple	28.4	31.9	39.9	100.2	1	29.0	34.7	40.6	104.3	1	31.9	44.0	56.7	132.6	1	24.6	33.4	46.2	104.2	1	9.9	9.9	11.7	31.5	3
Box elder	28.4	28.4	10.6	67.4	2	30.0	32.0	14.1	76.1	2	21.7	19.7	10.1	51.5	2	19.5	22.3	17.6	59.4	2	8.9	8.5	11.9	29.3	4
Hackberry	7.6	7.4	5.1	20.1	5	11.4	9.1	13.2	33.7	4	7.2	4.7	2.7	14.6	6	12.8	13.4	10.6	36.8	3	17.1	19.7	24.6	61.4	1
Sycamore	8.7	8.8	29.3	46.8	3	1.0	.6	7.6	9.2	6	7.3	10.4	8.6	26.3	3	5.9	4.4	3.2	13.5	6	4.9	4.9	16.3	26.1	5
Cottonwood	8.7	8.1	9.4	26.2	4	9.3	9.9	15.5	34.7	3	3.0	2.3	4.4	9.7	7	6.8	5.0	11.8	23.6	4	.8	.7	.2	1.7	16
Slippery elm	6.5	4.7	2.8	14.0	6	8.3	5.9	2.6	16.8	5	12.5	8.7	3.3	24.5	4	5.9	4.4	1.0	11.3	7	13.8	14.0	5.9	33.7	2
Black walnut	4.3	4.7	.9	9.9	7	3.0	2.6	3.3	8.9	7	4.1	2.3	3.3	9.7	8	7.7	5.5	4.0	17.2	5	9.8	8.5	3.0	21.3	7
Green ash	3.3	2.0	.4	5.7	8	3.0	2.0	1.3	6.3	8	8.3	5.8	5.7	19.8	5	5.9	2.8	1.4	10.1	7	8.2	8.6	7.2	24.0	6
Black willow	1.0	2.0	1.2	4.2	9	2.0	1.3	1.3	4.6	9	--	--	--	--	--	1.7	1.1	.2	3.0	11	.8	.7	.3	1.8	15
Ohio buckeye	--	--	--	--	--	--	--	--	--	--	1.0	.5	--	1.5	11	3.3	3.3	.6	7.2	8	4.9	4.2	1.7	10.8	11
Osage orange	--	--	--	--	--	--	--	--	--	--	2.0	1.1	4.8	7.9	9	--	--	--	--	--	2.3	2.1	1.0	5.5	13
Bur oak	2.1	1.4	.3	3.8	10	2.0	1.3	.1	3.4	10	--	--	--	--	--	--	--	--	--	--	2.4	2.8	6.4	11.6	9
Bitternut hickory	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2.6	1.7	2.7	7.0	9	--	--	--	--	--
Basswood	--	--	--	--	--	--	--	--	--	--	1.0	.5	.4	1.9	10	.8	.5	--	1.3	12	3.2	2.8	1.8	7.8	12
Red haw	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1.7	1.1	.4	3.2	10	1.6	1.4	.4	3.4	14
Honey locust	--	--	--	--	--	1.0	.6	.4	2.0	11	--	--	--	--	--	--	--	--	--	--	4.9	4.9	3.6	13.4	8
Red oak	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	4.0	4.2	3.1	11.3	10
Others[1]	1.0	.6	.1	1.7		--	--	--	--		--	--	--	--		.8	1.1	.3	2.2		2.4	2.1	.9	5.4	

[1]Others with importance values ≤3.0 (1% of total IV) include red mulberry, Kentucky coffee-tree, chinquapin oak, and sassafras.

TABLE 2

Understory Vegetation on 5 Floodplain Forest Sites in Central Illinois Ranked in Descending Order of Mean RF and RD Index for Sites A Through D. The RF +RD Index Is Derived From Combined RF and RD Values.

	A 541 stems/ha		B 289 stems/ha		C 590 stems/ha		D 799 stems/ha		E 1272 stems/ha	
Species	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RF Index	RF+RD Rank
Box elder	52.2	1	51.5	1	36.3	1	53.9	1	8.4	8
Grape	32.9	2	15.8	4	31.4	2	18.6	2	45.8	1
Silver maple	18.9	4	31.1	2	14.7	7	14.5	7	6.5	9
Slippery elm	6.6	8	25.6	3	28.6	3	17.1	3	13.8	5
Poison-ivy	25.6	3	11.5	6	20.8	5	16.5	4	15.5	4
Hackberry	17.0	5	14.3	5	20.2	6	15.6	6	32.2	2
Greenbrier	12.9	7	4.6	10	23.5	4	15.9	5	18.5	3
Elderberry	16.0	6	10.3	7	2.8	10	10.2	8	3.9	14
Green ash	6.6	8	9.9	8	5.4	9	3.9	10	1.5	15
Virginia creeper	4.9	9	3.0	13	6.0	8	3.2	11	--	--
Ohio buckeye	--	--	3.0	12	--	--	9.8	9	11.1	6
Mulberry	--	--	7.8	9	1.3	12	1.2	14	--	--
Basswood	--	--	4.6	11	--	--	1.2	13	5.6	10
Sycamore	--	--	1.4	14	1.9	11	--	--	4.0	13
Sassafras	--	--	1.4	15	--	--	1.2	16	9.7	7
Trumpet vine	--	--	--	--	1.3	13	1.2	15	4.9	12
American bladdernut	--	--	--	--	--	--	1.8	12	5.4	11
Others[1]	4.9		5.4		5.8		14.3		11.4	

[1]Others having a mean RF + RD Index value < 1.2 include coralberry, bitternut hickory, black walnut, apple tree, catalpa, red haw, wahoo, buttonbush, osage orange, Kentucky coffee-tree, black cherry, honey locust, red oak, bur oak, pawpaw.

TABLE 3

Ground Cover Vegetation on 5 Floodplain Forest Sites in Central Illinois Ranked in Descending Order of Mean RF and RD Index for Sites A Through D.

Percent Bare ground	A 37.5		B 38.6		C 40.7		D 33.7		E 30.1	
Species	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank	RF+RD Index	RF+RD Rank
Grasses[1]	70.9	1	91.7	1	58.1	1	85.6	1	83.8	1
Nettle	47.6	2	12.4	6	51.1	2	58.0	2	19.6	3
Aster	17.0	5	13.5	4	41.1	3	14.4	3	15.2	4
Poison-ivy	26.1	3	28.0	2	13.3	5	12.7	4	48.6	2
Coneflower	19.4	4	19.3	3	3.1	8	10.9	5	--	--
Violet	6.3	6	2.8	9	13.8	4	--	--	3.6	7
Horseweed	--	--	13.4	5	6.9	6	--	--	8.9	6
Clearweed	3.2	8	3.8	8	--	--	5.9	7	2.6	8
Smart weed	--	--	5.8	7	6.3	7	--	--	2.6	9
Waterleaf	--	--	--	--	--	--	7.5	6	--	--
Coralberry	6.3	7	--	--	--	--	--	--	--	--
Trumpet vine	--	--	2.0	10	--	--	2.5	8	--	--
Honewort	--	--	--	--	3.1	9	2.5	9	--	--
Grape	3.2	9	--	--	--	--	--	--	8.9	5
Others[2]	--	--	5.4	--	3.2		6.2			

[1]Grasses include: Poa compressa, Cinna arundinaceae, Leersia virginica, Elymus virginicus, Muhlenbergia tenuiflora, Setaria faberrii, Hystrix patula, Leersia oryzoides, Muhlenbergia frondosa, Echinochloa crusgalli, Panicum dicholomiflorum, and Carex sp. (sedge).

[2]Others include those with a mean RF and RD Index value $\leq$ 1.1 and include beggar-tick, crownbeard, elderberry, jewel-weed, and wild ginger.

TABLE 4

Breeding Birds on 5 Floodplain Forest Sites in Central Illinois Expressed as the Number of Pairs Per 40 ha (100 Acres). Species Are Listed in Descending Order of Mean Density for Areas A Through D.

Species	Habitat[1]	Nesting stratum[2]	A	B	C	D	E	Mean values (areas A-D)
Indigo bunting	E	LO	19	26	27	15	38	21.8
House wren	I	HN	12	16	19	11	22	14.5
Red-headed woodpecker	E	HN	12	13	16	16	4	14.3
Acadian flycatcher	I	LO	12	.6	16	21	31	13.8
Cardinal	E	LO	12	11	13	13	18	12.3
Song sparrow	E	LO	16	10	10	8	27	11.0
Tufted titmouse	I	HN	8	10	13	11	9	10.5
Warbling vireo	E	HO	19	3	6	3	13	7.8
Downy woodpecker	I	HN	4	6.	10	11	9	7.8
Eastern wood pewee	I	HO	8	6	6	8	9	7.0
Great crested flycatcher	I	HN	4	10	3	8	9	6.3
Red-eyed vireo	I	LO	16	3	3	3	4	6.3
Blue-gray gnatcatcher	I	HO	12	3	3	+	4	6.3
Carolina chickadee	I	HN	4	3	10	5	9	5.5
Yellow-throated warbler	I	HO	16	+	6	+	+	5.5
Carolina wren	I	LO	8	3	6	3	9	5.0
Northern oriole	E	HO	4	13	+	3	4	5.0
Common yellowthroat	E	LO	4	10	3	3	4	5.0
Eastern kingbird	E	HO	12	+	3	5	4	5.0
American redstart	I	LO	19	+	+	+	13	4.8
Starling	E	HN	12	+	3	3	4	4.5
American robin	E	LO	12	6	+	+	0	4.5
Yellow-billed cuckoo	I	LO	8	6	+	3	13	4.3
Prothonotary warbler	I	HN	12	0	+	5	4	4.3
Red-bellied woodpecker	I	HN	4	6	3	3	9	4.0
American goldfinch	E	LO	7	+	3	5	4	3.8
Common flicker	E	HN	4	3	3	5	4	3.8
Common grackle	E	LO	4	10	+	+	+	3.5
House sparrow	E	HN	4	3	3	3	+	3.3
Yellow-throated vireo	I	HO	8	0	+	3	+	2.8
Gray catbird	E	LO	4	3	+	3	4	2.5
Wood duck	I	HN	4	+	3	3	+	2.5
White-breasted nuthatch	I	HN	+	6	+	3	+	2.3
Northern parula	I	HO	+	+	3	5	+	2.0
Blue jay	E	LO	4	+	+	3	+	1.8
Brown thrasher	E	LO	4	+	+	+	+	1.0
Eastern phoebe	E	LO	4	+	+	+	+	1.0
Field sparrow	E	LO	+	3	+	+	4	.8
Wood thrush	I	LO	+	+	0	3	+	.8
Mourning dove	E	LO	+	+	+	3	+	.8
Red-winged blackbird	E	LO	+	+	+	+	4	+
Area length (km)			1.2	1.4	1.2	1.8	1.2	1.4
Area size (ha)			10.3	12.4	12.4	15.0	9.0	12.5
Number of species			35	26	25	32	28	29.5
Pairs/40 ha[3]			310	202	205	192	297	230.0
Species diversity (H')			3.458	3.074	2.972	3.223	3.074	3.182
Equitability (J')			.97	.94	.92	.93	.92	.94

[1]E = edge, I = interior. [2]LO = low open, HO = high open, HN = hole nester.
[3]Difference in column sums and total values due to rounding errors.

TABLE 5

Male Birds Observed on Two Canoe Trips Down the Embarras River Listed in Descending Order of Combined Mean Density. Numbers Represent Avian Densities at Half-Hour Intervals Converted to Birds Observed Per Km.

Species	Trip 1 (June 21)			Trip 2 (June 27)			Combined mean
	Low	Mean	High	Low	Mean	High	
Indigo bunting	0.8	3.5	7.0	2.4	4.0	6.8	3.8
Acadian flycatcher	2.0	2.6	3.3	0.8	2.8	4.4	2.7
Song sparrow	0.4	2.2	4.2	0.4	2.7	4.8	2.4
Common grackle	0.4	2.3	5.0	0.0	1.3	3.2	1.8
Tufted titmouse	0.0	1.3	2.0	0.8	1.7	3.2	1.5
Cardinal	0.8	1.4	2.5	0.0	1.4	2.4	1.4
Warbling vireo	0.0	1.5	3.8	0.4	1.2	2.4	1.4
Eastern wood pewee	0.4	1.2	2.0	0.4	1.5	2.4	1.4
Carolina chickadee	0.4	1.0	2.5	0.0	1.3	3.2	1.2
House wren	0.0	1.0	2.9	0.0	1.0	2.4	1.0
Red-headed woodpecker	0.0	0.9	2.0	0.4	1.1	2.8	1.0
Yellow-billed cuckoo	0.0	0.9	1.7	0.0	1.0	2.4	1.0
Blue-gray gnatcatcher	0.0	1.0	2.5	0.0	0.9	2.4	1.0
Downy woodpecker	0.4	0.8	1.3	0.0	0.9	1.6	0.8
Red-eyed vireo	0.0	0.8	2.0	0.0	0.8	2.8	0.8
American goldfinch	0.0	0.6	1.7	0.0	1.0	2.4	0.8
Carolina wren	0.0	0.8	2.9	0.0	0.6	1.6	0.7
Prothonotary warbler	0.4	0.6	0.8	0.0	0.8	1.6	0.7
Common yellowthroat	0.0	0.4	0.8	0.0	0.7	1.6	0.6
Eastern kingbird	0.0	0.6	1.3	0.0	0.5	1.6	0.6
Yellow-throated warbler	0.0	0.4	1.3	0.4	0.7	1.2	0.6
Great crested flycatcher	0.0	0.5	1.3	0.0	0.6	1.6	0.6
Northern parula	0.0	0.6	1.3	0.0	0.4	1.2	0.5
House sparrow	0.0	0.6	2.0	0.0	0.4	1.2	0.5
Northern oriole	0.0	0.8	1.7	0.0	0.2	0.4	0.5
Red-winged blackbird	0.0	0.6	2.0	0.0	0.4	1.2	0.5
Mourning dove	0.0	0.3	0.8	0.4	0.6	1.2	0.5
American redstart	0.0	0.6	2.5	0.0	0.3	1.6	0.5
Red-bellied woodpecker	0.0	0.5	1.3	0.0	0.4	1.2	0.5
Blue jay	0.0	0.5	2.0	0.0	0.3	0.8	0.4
Gray catbird	0.0	0.3	1.3	0.0	0.4	0.8	0.4
White-breasted nuthatch	0.0	0.3	0.4	0.0	0.4	1.2	0.4
Others[1]	0.0	4.3	1.3	0.0	2.6	2.0	3.5
Total		35.8			34.9		36.0

[1]Species recorded at a combined mean density $\leq .2$ km per hour: wood duck, turkey vulture, red-tailed hawk, bobwhite, chimney swift, ruby-throated hummingbird, common flicker, hairy woodpecker, eastern phoebe, barn swallow, common crow, brown thrasher, American robin, wood thrush, eastern bluebird, cedar waxwing, starling, yellow-throated vireo, black-and-white warbler, yellow warbler, cerulean warbler, Louisiana waterthrush, yellow-breasted chat, orchard oriole, scarlet tanager, rose-breasted grosbeak, rufous-sided towhee, chipping sparrow, field sparrow.

TABLE 6

Relative Density, Determined as a Percentage of the Mean of Each Bird Species Found in Both the Study Sites and River Breeding Bird Censuses.

Species	Study Sites A - D	River census	Extreme differences
Indigo bunting	9.5	11.6	
House wren	6.3	3.0	A[2]
Red-headed woodpecker	6.2	3.0	A
Acadian flycatcher	6.0	8.2	
Cardinal	5.3	4.3	
Song sparrow	4.8	7.3	B[3]
Tufted titmouse	4.6	4.6	
Warbling vireo	3.4	4.3	
Downy woodpecker	3.4	2.4	
Eastern wood powee	3.0	4.3	
Great crested flycatcher	2.7	1.8	A
Red-eyed vireo	2.7	2.4	
Blue-gray gnatcatcher	2.7	3.0	
Carolina chickadee	2.4	3.6	B
Yellow-throated warbler	2.4	1.8	
Carolina wren	2.2	2.1	
Northern oriole	2.2	1.5	A
Common yellowthroat	2.2	1.8	
Eastern kingbird	2.2	1.8	
American redstart	2.1	1.2	A
Starling	2.0	.3	A
American robin	2.0	.3	A
Yellow-billed cuckoo	1.9	3.0	B
Prothonotary warbler	1.9	2.1	
Red-bellied woodpecker	1.7	1.2	
American goldfinch	1.6	2.4	B
Common flicker	1.6	.3	A
Common grackle	1.5	5.5	B
House sparrow	1.4	1.5	
Yellow-throated vireo	1.2	.3	A
Gray catbird	1.1	1.2	
Wood duck	1.1	.3	A
White-breasted nuthatch	1.0	1.2	
Northern parula	0.9	1.5	B
Blue jay	0.8	1.2	B
Mourning dove	0.3	1.2	B
Red-winged blackbird	0.3	1.5	B
Others[1]	1.7	1.7	
Total	100.3%	100.7%	

[1]Species with a relative density of < 1.0 percent on both the river and field study censuses include field sparrow, brown thrasher, eastern phoebe, wood thrush.

[2]A designates those species with a relative density at least one and one-half times greater on the field study sites.

[3]B designates those species with a relative density at least one and one-half times greater on the river censuses.

TABLE 7

A Comparison of Principal Vegetation and Breeding-Bird Populations Between Areas A Through D and E.

Species	A - D Index	E Index
Area size (ha)	12.5	9.0
Area length (km)	1.4	1.2
Canopy trees	340.4 trees/ha	314.3 trees/ha
Silver maple	110.3[1]	31.5
Box elder	63.6	29.3
Hackberry	26.3	61.4
Sycamore	24.0	26.1
Cottonwood	23.6	1.7
Slippery elm	16.7	33.7
Understory vegetation	544.8 stems/ha	1272 stems/ha
Box elder	48.5[2]	8.2
Grape	24.7	45.8
Silver maple	19.8	6.5
Slippery elm	19.5	13.6
Poison ivy	18.6	15.3
Hackberry	16.8	32.1
Greenbrier	14.2	18.5
Ground cover		
Grasses	76.6[2]	83.8
Nettle	42.3	19.6
Aster	21.5	15.2
Poison ivy	20.0	48.6
Coneflower	13.2	0.0
% bare ground	37.6	30.1
Breeding birds	230.0 prs/40 ha	297 prs/40 ha
Indigo bunting	21.8	38
House wren	14.5	22
Red-headed woodpecker	14.3	4
Acadian flycatcher	13.8	31
Cardinal	12.3	18
Song sparrow	11.0	27
Tufted titmouse	10.5	9
Warbling vireo	7.8	13
Downy woodpecker	7.8	9
Eastern wood pewee	7.0	9
Great crested flycatcher	6.3	9
Red-eyed vireo	6.3	4
Blue-gray gnatcatcher	6.3	4
Carolina chickadee	5.5	9
Yellow-throated warbler	5.5	+
Carolina wren	5.0	9
Northern oriole	5.0	4
Common yellowthroat	5.0	4
Eastern kingbird	5.0	4
American redstart	4.8	13
Starling	4.5	4
American robin	4.5	0
Yellow-billed cuckoo	4.3	13
Prothonotary warbler	4.3	4
Red-bellied woodpecker	4.0	9

[1]Mean importance value
[2]Mean RF + RD Index

TABLE 8

Floodplain-Forest Breeding Birds from Coles, Piatt, and Vermillion Counties[1] in Central Illinois Expressed in Pairs Per 40 Ha.

Species	Coles Areas A - E			Piatt	Vermillion
	Low	Mean	High		
Indigo bunting	15	25.0	38	16	13
Acadian flycatcher	6	17.2	31	12	23
House wren	11	16.0	22	12	
Song sparrow	8	14.2	27		
Cardinal	11	13.4	18	16	
Red-headed woodpecker	4	12.2	16	24	16
Tufted titmouse	8	10.2	13	12	26
Warbling vireo	3	8.8	19		26
Downy woodpecker	4	8.0	11	8	23
Eastern wood pewee	6	7.4	9	14	19
Great crested flycatcher	3	6.8	10	14	13
American redstart	+	6.4	19	30	32
Chicadee sp.[2]	3	6.2	10	8	29
Yellow-billed cuckoo	+	6.0	13	10	6
Carolina wren	3	5.8	9	10	3
Red-eyed vireo	3	5.8	16	12	13
Red-billed woodpecker	3	5.0	9	12	19
Northern oriole	+	4.8	13		6
Common yellowthroat	3	4.8	10	4	6
Eastern kingbird	+	4.8	12		
Starling	+	4.4	12	2	32
Blue-gray gnatcatcher	+	4.4	12	8	13
Yellow-throated warbler	+	4.4	16	4	
Prothonotary warbler	0	4.2	12		13
Common flicker	3	3.8	5	12	23
American goldfinch	+	3.8	7		6
American robin	0	3.6	12		6
Gray catbird	+	2.8	4	10	
Yellow-throated vireo	0	2.2	8	4	
Wood duck	+	2.0	4		13
White-breasted nuthatch	+	1.8	6	12	6
Northern parula	+	1.6	5		13
Blue jay	+	1.4	4	4	13
Wood thrush	0	.6	3		10
Cerulean warbler				12	13
Hairy woodpecker				4	13
Kentucky warbler					26
Others[3]		11		6	3
Area size (ha)		11.8		10.1	6.2
Number of species		25-35		29	31
Number of pairs/40 ha		241		298	490
Species diversity (H')		3.157		3.206	3.211
Equitability (J')		.94		.94	.94

[1]From this study, Hudson (1968), and Karr (1968) respectively.
[2]Carolina chickadee breeding in Coles and Vermillion counties and black-capped chickadee in Piatt county.
[3]Species appearing in densities of ≤ 3 pairs per 40 ha on all three censuses include ruby-throated hummingbird, brown creeper, yellow-breasted chat, common grackle, house sparrow, field sparrow, brown thrasher, eastern phoebe, mourning dove.

TABLE 9

Breeding Birds from West to East Across The Eastern Deciduous Forest from Kansas (Zimmerman and Tatschl 1975), Illinois (This Study) and Maryland (Criswell Et At. 1973) Given in Pairs Per 40 Ha.

Species	Kansas	Illinois Low	Illinois Mean A-E	Illinois High	Maryland
Acadian flycatcher	2	6	17.2	31	59
Cardinal	24	11	13.4	18	21
Tufted titmouse	14	8	10.2	13	32
Downy woodpecker	7	4	8.0	11	21
Eastern wood pewee	7	6	7.4	9	16
Great crested flycatcher	17	3	6.8	10	11
Red-eyed vireo	11	3	5.8	16	59
Carolina wren	5	3	5.8	9	37
Red-bellied woodpecker	19	3	5.0	9	11
Starling	2	+	4.4	12	85
White-breasted nuthatch	5	+	1.8	6	5
Northern parula	10	+	1.6	5	48
Rose-breasted grosbeak	22				
Black-capped chickadee	14				
Wood thrush	13				
Rufous-sided towhee	12				
Hairy woodpecker	7				
Indigo bunting	12	15	25.0	38	
Red-headed woodpecker	7	4	12.2	16	
Yellow-billed cuckoo	2	+	6.0	13	
Northern oriole	19	+	4.8	13	
Common flicker	5	3	3.8	5	
Yellow-throated vireo	2	0	2.2	8	
Blue jay	10	+	1.4	4	
Mourning dove	5	+	.6	3	
House wren		11	16.0	22	
Song sparrow		8	14.2	27	
Warbling vireo		3	8.8	19	
Common yellowthroat		3	4.8	10	
Eastern kingbird		+	4.8	12	
Yellow-throated warbler		+	4.4	16	
American goldfinch		+	3.8	7	
American robin		0	3.6	12	
Gray catbird		+	2.8	4	
Common grackle		+	2.8	10	
House sparrow		+	2.6	4	
American redstart		+	6.4	19	21
Carolina chickadee		3	6.2	10	16
Blue-gray gnatcatcher		+	4.4	12	5
Prothonotary warbler		0	4.2	12	16
Wood duck		+	2.0	4	16
Veery					11
Barred owl					5
Pileated woodpecker					5
Scarlet tanager					5
Others[1]	6		5.0		0
Area size (ha)	16.7		11.8		7.6
Number of species	30		25-35		21
Number of pairs/40 ha	271		241		505
Species diversity (H')	3.165		3.157		2.709
Equitability	.93		.94		.89

[1] Species appearing in densities of $\leq$ 2 pairs per 40 ha on all three censuses include yellow warbler, Kentucky warbler, summer tanager, field sparrow, brown thrasher, eastern phoebe, red-winged blackbird, wood thrush.

Appendix 1 - Scientific Names for Canopy Trees Appearing in This Paper.

Aceraceae
- Box elder *Acer negundo*
- Silver maple *Acer saccharinum*

Fagaceae
- Shingle oak *Quercus imbricaria*
- Bur oak *Quercus macrocarpa*
- Chinquapin oak *Quercus muhlenbergii*
- Red oak *Quercus rubra*

Hippocastanaceae
- Ohio buckeye *Aesculus glabra*

Juglandaceae
- Bitternut hickory *Carya cordiformis*
- Black walnut *Jugans nigra*

Lauraceae
- Sassafras *Sassafras albidum*

Leguminosae
- Honey locust *Gleditsia triacanthos*
- Kentucky coffee-tree *Gymnocladus dioicus*

Moraceae
- Osage orange *Maclura pomifera*
- Red mulberry *Morus rubra*

Oleaceae
- Green ash *Fraxinus lanceolata*

Platanaceae
- Sycamore *Platanus occidentalis*

Rosaceae
- Red haw *Crataegus mollis*

Salicaceae
- Cottonwood *Populus deltoides*
- Black willow *Salix nigra*

Tiliaceae
- Basswood *Tilia americana*

Ulmaceae
- Hackberry *Celtis occidentalis*
- Slippery elm *Ulmus rubra*

Appendix 2 - Scientific Names for Understory Plants Appearing in This Paper[1]

Anacardiaceae
Poison-ivy Rhus radicans

Annonaceae
Pawpaw Asimina triloba

Bignoniaceae
Trumpet vine Campsis radicans
Catalpa Catalpa speciosa

Caprifoliaceae
Elderberry Sambucus canadensis
Coralberry Symphoricarpos orbiculatus

Celastraceae
Wahoo Euonymus atropurpureus

Liliaceae
Greenbrier Smilax glauca

Rosaceae
Apple tree Malus punila
Black cherry Prunus serotina

Rubiaceae
Buttonbush Cephalanthus occidentalis

Staphyleaceae
American bladdernut Staphylea trifolia

Vitaceae
Virginia creeper Parthenocissus quinquefolia
Grape Vitis sp.

[1]Understory plants also part of the canopy stratum are listed only in Appendix 1.

Appendix 3 - Scientific Names for Ground Cover Plants Appearing in This Paper.[1]

Aristolochiaceae
Wild ginger Asarum sp.

Balsaminaceae
Jewel-weed Impatiens sp.

Compositae
Aster Aster sp.
Beggar-tick Bidens sp.
Horseweed Erigeron canadensis
Coneflower Rudbeckia sp.
Crownbeard Verbesina sp.

Cyperaceae
Sedge Carex sp.

Gramineae
Wood reed Cinna arundinaceae
Barnyard grass Echinochloa crusgalli
Wild rye Elymus virginicus
Bottlebrush grass Hystrix patula
Cut grass Leersia oryzoides
White grass Leersia virginica
Muhlenbergia frondosa
Muhlenbergia tenuiflora
Fall panicum Panicum dicholomiflorum
Giant foxtail Setaria faberrii

Hydrophyllaceae
Waterleaf Hydrophyllum sp.

Polygonaceae
Smartweed Polygonum sp.

Umbelliferae
Honewort Cryptotaenia canadensis

Urticaceae
Clearweed Pilea pumila
Nettle Laportea canadensis

Violaceae
Violet Viola papilionacea

[1]Ground cover plants also part of the understory stratum are listed only in Appendix 2.

Appendix 4 - Scientific Names for Birds Appearing in This Paper.

Wood duck	*Aix sponsa*
Turkey vulture	*Cathartes aura*
Red-tailed hawk	*Buteo jamaicensis*
Bobwhite	*Colinus virginianus*
Mourning dove	*Zenaida macroura*
Yellow-billed cuckoo	*Coccyzus americanus*
Barred owl	*Strix varia*
Chimney swift	*Chaetura pelagica*
Ruby-throated hummingbird	*Archilochus colubris*
Common flicker	*Colaptes auratus*
Pileated woodpecker	*Dryocopus pileatus*
Red-bellied woodpecker	*Centurus carolinus*
Red-headed woodpecker	*Melanerpes erythrocephalus*
Hairy woodpecker	*Dendrocopos villosus*
Downy woodpecker	*Dendrocopos pubescens*
Eastern kingbird	*Tyrannus tyrannus*
Great crested flycatcher	*Myiarchus crinitus*
Eastern phoebe	*Sayornis phoebe*
Acadian flycatcher	*Empidonax virescens*
Eastern wood pewee	*Contopus virens*
Barn swallow	*Hirundo rustica*
Blue jay	*Cyanocitta cristata*
Common crow	*Corvus brachyrhynchos*
Black-capped chickadee	*Parus atricapillus*
Carolina chickadee	*Parus carolinensis*
Tufted titmouse	*Parus bicolor*
White-breasted nuthatch	*Sitta carolinensis*
Brown creeper	*Certhia familiaris*
House wren	*Troglodytes aedon*
Carolina wren	*Thryothorus ludovicianus*
Gray catbird	*Dumetella carolinensis*
Brown thrasher	*Toxostoma rusum*
American robin	*Turdus migratorius*
Wood thrush	*Hylocichla mustelina*
Veery	*Catharus fuscescens*
Eastern bluebird	*Sialia sialis*
Blue-gray gnatcatcher	*Polioptila caerulea*
Cedar waxwing	*Bombycilla cedrorum*
Starling	*Sturnus vulgaris*
Yellow-throated vireo	*Vireo flavifrons*
Red-eyed vireo	*Vireo olivacea*
Warbling vireo	*Vireo gilvus*
Black-and-white warbler	*Mniotilta varia*
Prothonotary warbler	*Protonotaria citrea*
Northern parula	*Parula americana*
Yellow warbler	*Dendroica petechia*
Cerulean warbler	*Dendroica cerulea*
Yellow-throated warbler	*Dendroica dominica*

Appendix 4 - continued

Louisiana waterthrush	Seiurus motacilla
Kentucky warbler	Oporornix formosus
Common yellowthroat	Geothlypis trichas
Yellow-breasted chat	Icteria virens
American redstart	Setophaga ruticilla
House sparrow	Passer domesticus
Red-winged blackbird	Agelaius phoeniceus
Orchard oriole	Icterus spurius
Northern oriole	Icterus galbula
Common grackle	Quiscalus quiscula
Brown-headed cowbird	Molothrus ater
Scarlet tanager	Piranga olivacea
Summer tanager	Piranga rubra
Cardinal	Cardinalis cardinalis
Rose-breasted grosbeak	Pheucticus ludovicianus
Indigo bunting	Passerina cyanea
American goldfinch	Spinus tristis
Rufous-sided towhee	Pipilo erythrophthalmus
Chipping sparrow	Spizella passerina
Field sparrow	Spizella pusilla
Song sparrow	Melospiza melodia