JAMES ROBERT SCHINNER

Ph. D.

1974

AN ANALYSIS OF THE INTERRELATIONSHIP OF

[illegible] IN METROPOLITAN DETROIT

Thesis for the Degree of Ph. D.

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This is to certify that the

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AN ANALYSIS OF THE INTERRELATIONSHIP OF HABITAT AND

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presented by

James Robert Schinner

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ABSTRACT

AN ANALYSIS OF THE INTERRELATIONSHIP OF HABITAT AND AVIFAUNA IN METROPOLITAN DETROIT

By

James Robert Schinner

The avifauna of five areas in metropolitan Detroit was studied during 1972 and 1973. Each area contained both a residential and a park subsection. Thirty-three habitat variables were measured, and the interrelationship between these and bird species diversity and the population estimates for seven selected species were examined. A questionnaire was utilized to determine the attitudes of urban residents toward birdlife.

The results of this study showed that although bird species diversity increased as one moved from the center of the city to the suburbs, the total bird population of each residential subsection remained fairly constant. Between 50 and 60 percent of the variance in bird species diversity and the population estimates for the cardinal and mourning dove in 1972 was accounted for by the habitat variables measured. The volume of buildings was shown to be significantly related to each of the eight dependent variables during both 1972 and 1973, while in 1972 the volume of all deciduous vegetation was shown to be related to all but two dependent variables.

The questionnaire revealed that most residents of each study area liked birds and watched them often. The cardinal, blue jay, and robin were highly regarded by residents of each area, even though these species were not always present in large numbers.

The results of this project are particularly applicable to new subdivision design, since major changes in the environment are needed to effect changes in bird species diversity and bird population levels. Areas of future research are discussed and include more detailed studies of the structure of both vegetation and buildings. Research must also be conducted to establish a unified wildlife policy which can be integrated into the urban planning process.

AN ANALYSIS OF THE INTERRELATIONSHIP OF HABITAT AND AVIFAUNA IN METROPOLITAN DETROIT

By

James Robert Schinner

A THESIS

Submitted to
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TO MY FATHER

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In addition to those listed above, I would like to express my gratitude to the Ford Motor Company, Dearborn Country Club, Woodmere Cemetery, and the residents of each study area who granted me permission to conduct various aspects of this study on their property.

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INTRODUCTION

The role of wildlife within urban environments has been previously pointed out by Davey (1967), Stearns (1967), Twiss (1967), and Thomas and DeGraaf (1972) and includes various recreational and educational benefits. A more subtle, but equally important role is the potential effect urban wildlife may have on non-urban wildlife management programs (Stearns, 1967). Because the majority of people in this country live in urban and suburban areas, much political power is in the hands of urban representatives. If these representatives and their constituents are not educated in outdoor recreation and the value of wildlife, then important legislation concerning game management and natural resources may fail to be enacted.

There has, to date, been little wildlife research conducted within metropolitan areas; much of what has been done has involved the control of undesirable species (Larson, 1971). Most of the literature on urban birds consists of noting species changes over a period of years. Walcott (1959) was able to compare changes in bird populations in Cambridge, Massachusetts, between 1860 and 1955, while Graber and Graber (1963) have noted changes in suburban bird populations in Illinois between 1906 and 1958. Studies of birdlife in the metropolitan Detroit region have been made between 1946 and 1965 (Kelly, Middleton, and Nickell, 1963; Kelly, 1966).

More detailed urban bird studies involving a consideration of breeding biology and density have been made by Mehner (1958), Kuroda (1964), Burr and Jones (1968), and Woolfenden and Rohwer (1969). There has been, to date, only one attempt to discover which elements of the environment affect avian abundance in an urban setting: Smith (1971) studied breeding bird populations and habitat in Reston, Virginia, but he was unable to show a direct relationship between the habitat variables he measured and bird abundance. A study by Dagg (1970) represents one of the few attempts to determine the attitudes of city dwellers toward the wildlife they see in their neighborhoods.

The present study was undertaken to identify, if possible, which habitat variable(s) in an urban setting is (are) responsible for the bird populations which are present. It is believed that the discovery of such a relationship is a necessary first step in managing urban bird populations. Because birdlife in the city cannot be managed without regard for the human population, a questionnaire was distributed to determine the attitudes of people toward birds.

The specific goals of the present study are as follows:

1. To identify the spring and summer birdlife associated with each study area.
2. To calculate the bird species diversity index associated with each study area.
3. To estimate population levels of important resident bird species in each study area.
4. To identify and describe important vegetative components of each study area.
5. To identify and describe important non-vegetative components of each study area.

6. To determine if a relationship exists between any of the measured habitat parameters and bird species diversity and the population density of the more important resident species.
7. To survey attitudes of residents of each study area toward birdlife.
8. To suggest management practices which may be of value in attracting and holding birds in an urban environment.

Other considerations are:

1. To measure possible effects of urban parks in supplying birds to surrounding residential areas.
2. To identify the fall and winter bird population present in each study area.
3. To compare the usefulness of bird census techniques utilized during the study.

STUDY AREAS

Five areas were chosen for intensive study; these are described below, beginning with the area closest to downtown Detroit and moving outward (Figure 1). Each study area has both a residential and a park subsection. The areas to be studied were selected using the following criteria: architectural features and age of the neighborhood; economic and social status of the residents; general status of existing vegetation; and type of park that is present.

Clark Area

The Clark study area (25.23 acres) is bordered on the north by Vernor Avenue and an alley, on the east by Clark Avenue, on the south by Cristiancy Avenue, and on the west by Lansing Avenue (Figure 2).

According to one resident whose father purchased land in the Clark study area in 1875, it was farmland until that date. During the mid-1870's land between Vernor Avenue and the Detroit River was subdivided, and housing construction was completed within a few years. The only new buildings in the area are some garages located in the residential subsection. The YMCA building was constructed around 1920.

Residential Subsection

Ninety-six houses are located in the residential subsection of the Clark study area. In addition, there are 57 garages, an empty store, and the Edsel Ford YMCA. House lots are generally 30 feet wide by 175 feet long between McKinstry Avenue and Clark Avenue and 30 feet

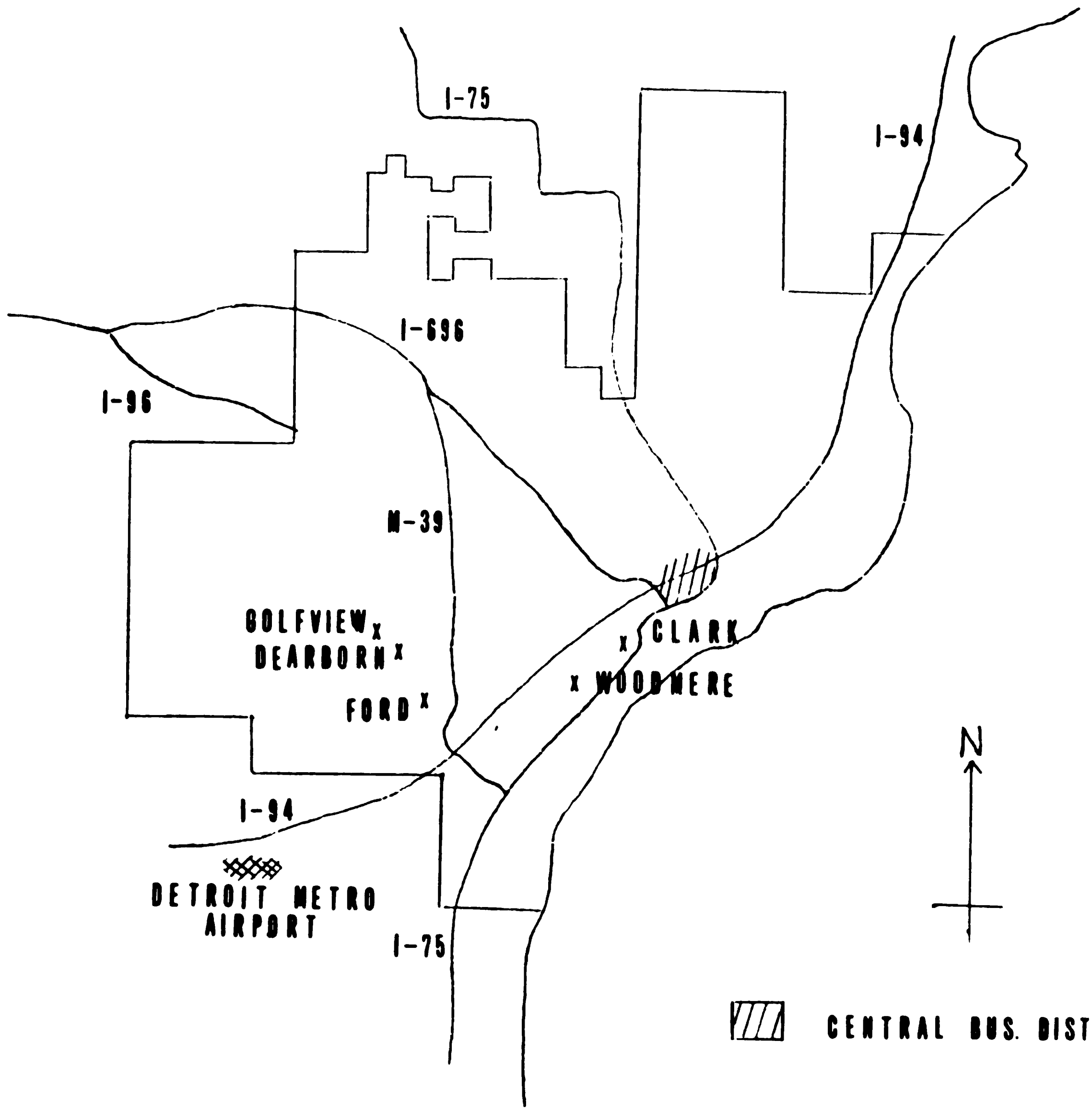

Figure 1. Study area locations within metropolitan Detroit.

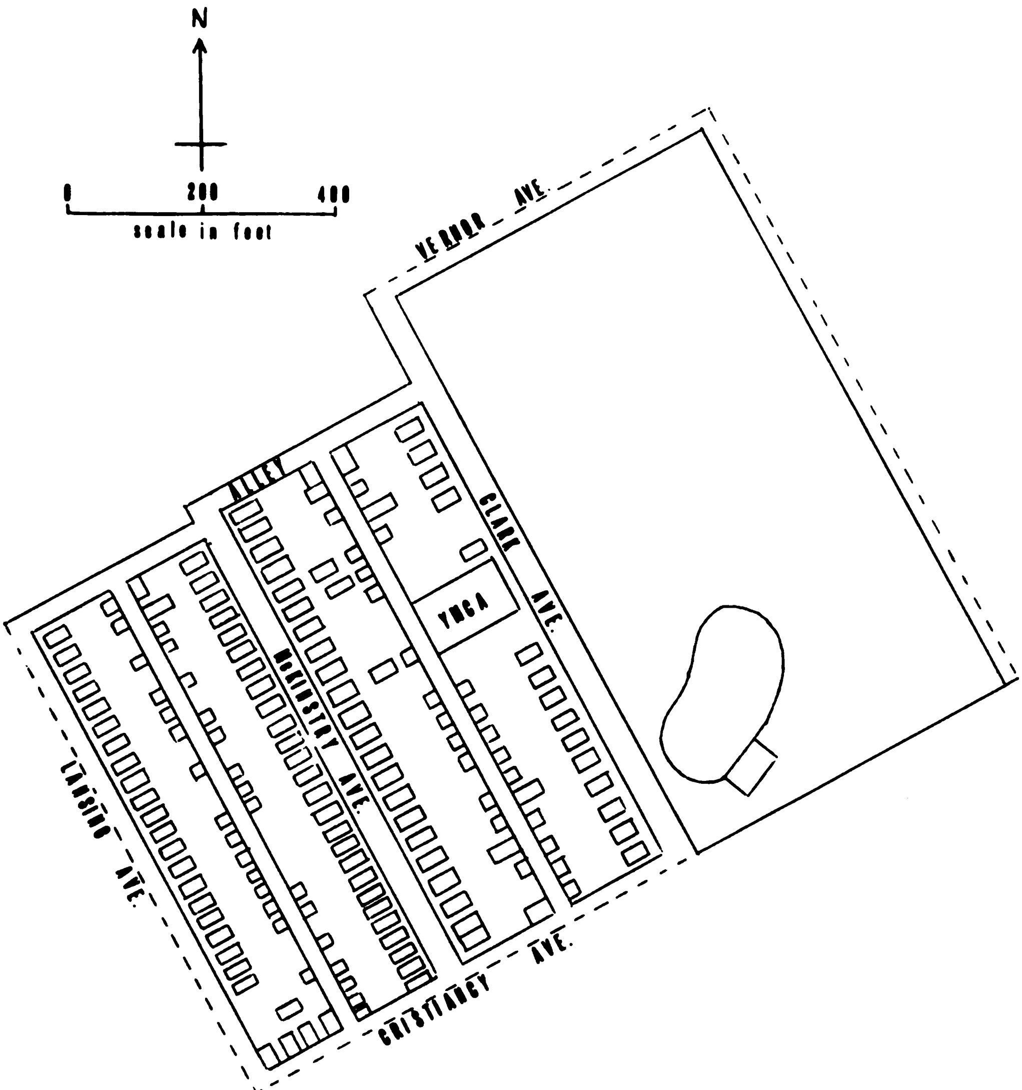

Figure 2. Clark study area.

by 155 feet between Lansing Avenue and McKinstry Avenue; these small lots give the area a crowded appearance. An alley separates the backyards in each block.

Houses located in the Clark study area are generally two-story frame structures (Figure 3). In several cases, two houses are located on a single lot. Houses are usually kept in a moderate degree of repair; however, some are in very poor condition.

The Clark area was originally settled by people of Irish descent; at the present time, Spanish-Americans are moving into the area. Residents are generally non-professional workers, although many are retired.

Street tree plantings are mature and consist largely of silver maple and American elm, with some sycamore also present; the general height of the plantings is from 50 to 60 feet. Yard vegetation is variable, but trees are generally mature. In addition to those species already mentioned, cherry, box elder, and ailanthus are also present. (For a complete listing of the trees encountered, see Appendix A, Table 1). Shrubs are generally less than five feet in height, with the majority reaching less than three feet. Privet, rose, lilac, and arborvitae are the most abundant species in the area. (See Appendix A, Table 1 for a complete listing of shrubs present).

Park Subsection

The park subsection of the Clark study area is 10.18 acres in size. It is generally open in appearance (Figure 4), and there are only 20 shrubs in the entire park. Trees average 45 to 55 feet in height, with little or no foliage below 12 feet. Most of the trees show a growth pattern typical of those planted in the open: height is not extreme and

Figure 3. Clark residential subsection.

Figure 4. Clark park subsection.

branches are spreading. Coverage by the canopy is approximately 50 percent. Numerous gravel pathways criss-cross the park, and there is a large, empty, concrete wading pond located in the southwest corner. Also located in this corner is a small maintenance building, around which are planted the only shrubs to be found in the park. Appendix A, Table 2 lists all of the trees and shrubs found in this subsection.

The park is used by different groups of people. A high school near the study area uses part of it for various outdoor sports. Most of the park, however, is devoted to passive recreation, such as feeding squirrels or relaxation by older people.

Woodmere Area

The Woodmere study area is 28.99 acres in size. The residential subsection of this area is bordered on the north by Avis Avenue, on the east by Elsmere Avenue, on the south by Homer Avenue, and on the west by Woodmere Avenue. The park subsection is part of Woodmere Cemetery and is bounded on the east by Woodmere Avenue (Figure 5).

Woodmere Cemetery was dedicated on July 14, 1869 (Farmer, 1890). The western edge of the cemetery was originally a wide marsh, most of which has since been filled. What must have been the center of this marsh is now a shipping channel. The residential subsection of this study area was probably developed soon after the Clark area was subdivided.

Residential Subsection

There are 164 houses located within the residential subsection of the Woodmere study area. As is the case with the Clark area, lots are 30 feet wide and an alley runs between adjoining backyards. Lots

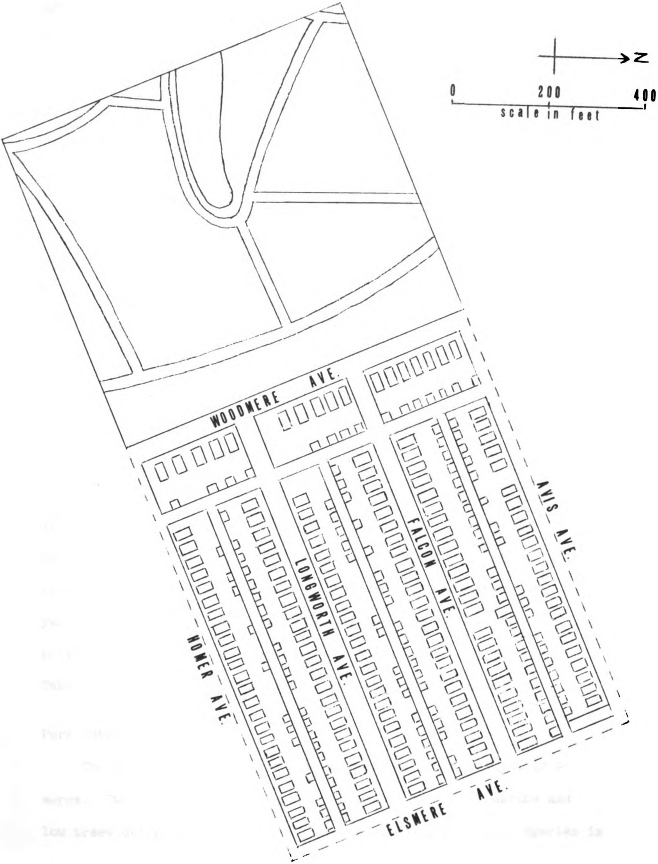

Figure 5. Woodmere study area.

are not, however, as deep as those in the Clark area: they measure only 110 feet in length. In addition to houses, there are also 125 garages and one store located in the subsection. This area is even more crowded in appearance than is the Clark residential subsection.

Most houses in this study area are two-story structures (Figure 6), although many of those along Homer Avenue have only one story. Both the front and backyards are small, with only a minor area devoted to lawn and shrubs; this is especially true if a garage or parking apron is present. Houses are generally in good repair; however, several are in very poor condition.

Most people living in the Woodmere area are non-professional workers, many of whom are employed at the nearby Ford Rouge River Plant. The ethnic background of the original property owners is not known. Some Spanish-speaking Americans are now moving into the predominantly white neighborhood.

Street plants consist largely of silver maple and black locust. These trees are between 50 and 60 feet in height. Yard trees are sparse, with silver maple, ailanthus, and American elm predominating; these are also generally mature. Shrubs are few in number, with some yards having none at all. When they are present, rose, barberry, privet, arborvitae, and lilac are the most abundant. (See Appendix A, Table 3 for a complete listing of trees and shrubs present).

Park Subsection

The park subsection of the Woodmere study area contains 12.21 acres. The cemetery has an open appearance, with a few shrubs and low trees being present (Figure 7). A wide variety of tree species is planted; these have an average height of between 45 and 60 feet. Species

Figure 6. Woodmere residential subsection.

Figure 7. Woodmere park subsection.

of maple predominate; however, there is a fair representation of oak. Shrubs are found mainly around the small pond and some grave sites. (See Appendix A, Table 4 for a listing of all trees and shrubs present). Coverage, excluding the pond area, is approximately 50 percent.

Woodmere Cemetery receives little recreational use. This was especially true the first year of study, when a strike of cemetery personnel kept traffic at a minimum. A few people were seen enjoying a walk, but most persons observed were visiting grave sites.

Ford Area

The Ford study area contains 25.03 acres of land. The residential subsection is bounded on the northeast by Snow Avenue, on the southeast by Edgewood Avenue, on the southwest by Ash Avenue, and on the northwest by Detroit Avenue. The park subsection is contained within a woodlot and is bordered on the southwest by Snow Avenue (Figure 8).

According to local residents, before 1945 this area contained only two houses; all of the other houses now present were built between 1945 and 1950. The forested subsection is under the ownership of the Ford Motor Company and has been wooded for at least the past 100 to 125 years.

Residential Subsection

There are 95 houses located within the residential subsection of the Ford study area. Unlike the Clark and Woodmere areas, there are no alleys between backyards. Houses are all single-story brick structures, and all but three of them have separate garages located behind them (Figure 9). Yards are 45 to 50 feet wide by 150 feet long.

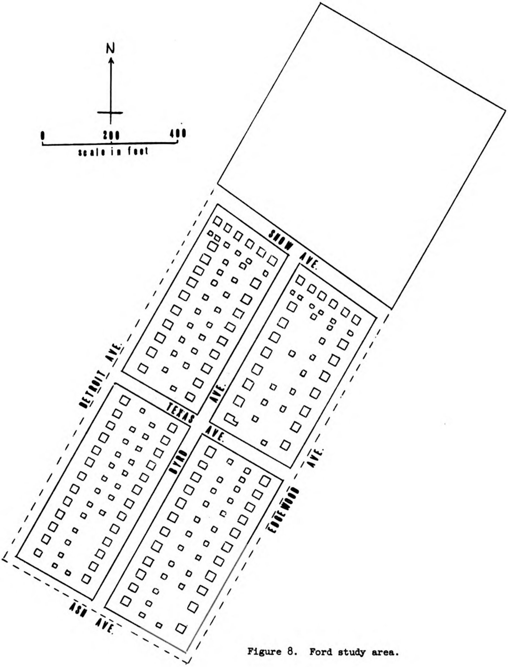

Figure 8. Ford study area.

Figure 9. Ford residential subsection.

Houses located in this area are kept in good repair. Many of the people living in the Ford area are blue-collar workers.

Street tree plantings are nearly all silver and Norway maple, with the latter being the most abundant. The silver maple are larger than are the Norway maple (50 feet as opposed to 30 feet). Yard plantings are more variable than the street plantings; American elm, some reaching a height of 55 to 60 feet, are fairly common. Other common yard trees are silver maple, apple, cherry, and plum. Shrubs in this area are more diverse than in either the Clark or Woodmere areas. Evergreen shrubs such as yew, juniper, and arborvitae are common, as are lilac and rose. A complete listing of trees and shrubs can be found below (Appendix A, Table 5).

Park Subsection

The park subsection of the Ford study area is 9.11 acres in size. The entire area is a mature woodland with an overstory reaching a height of 75 to 85 feet (Figure 10). Coverage of the overstory is approximately 70 to 80 percent, which allows enough light penetration of the canopy to foster the growth of a thick shrub layer; this shrub layer consists largely of spicebush, which reaches a height of 10 to 12 feet. Oaks and maples are the most abundant canopy trees; however, tulip poplar, cottonwood, and sycamore are also present in fair numbers. The northeastern edge of the park subsection is two to three feet lower than is the rest of the woodlot, thus allowing water to collect during most of the year. Silver maple and sycamore are more common in this area. (See Appendix A, Table 6 for a complete listing of trees and shrubs).

Figure 10. Ford park subsection.

Golfview Area

The Golfview study area includes 30.31 acres. The residential subsection is bounded on the north by Ford Road, on the southeast by Golfview Drive, and on the west by Hawthorn Drive. The park subsection is a portion of the Dearborn Country Club and is bounded on the north by Ford Road and on the northwest by Golfview Drive (Figure 11). Little information is available on the history of this study area, although it was probably developed in the early to mid-1950's.

Residential Subsection

There are 43 houses located within the Golfview study area; the only other buildings present are ten garages. Houses vary from single-story brick to two-story brick and two-story frame structures (Figure 12). The average lot size is 60 feet by 140 feet. All houses and yards are kept in excellent condition. Most persons living in this area have a professional background, and many are employed by the Ford Motor Company.

Street tree plantings are more variable in structure than those found in other study areas. Fifty-foot American elms line Wildwood Drive, while 20 to 30-foot Norway maples are planted along Russell Avenue (Figures 11 and 12). Yard plantings are also variable, which possibly reflects the original vegetation. Species of oak and hickory are present in yards along Golfview Drive. Other trees are more than likely planted; these include Norway and silver maple and species of spruce and pine. Shrubs planted around the houses also vary greatly, since many yards have been landscaped by professional landscape architects.

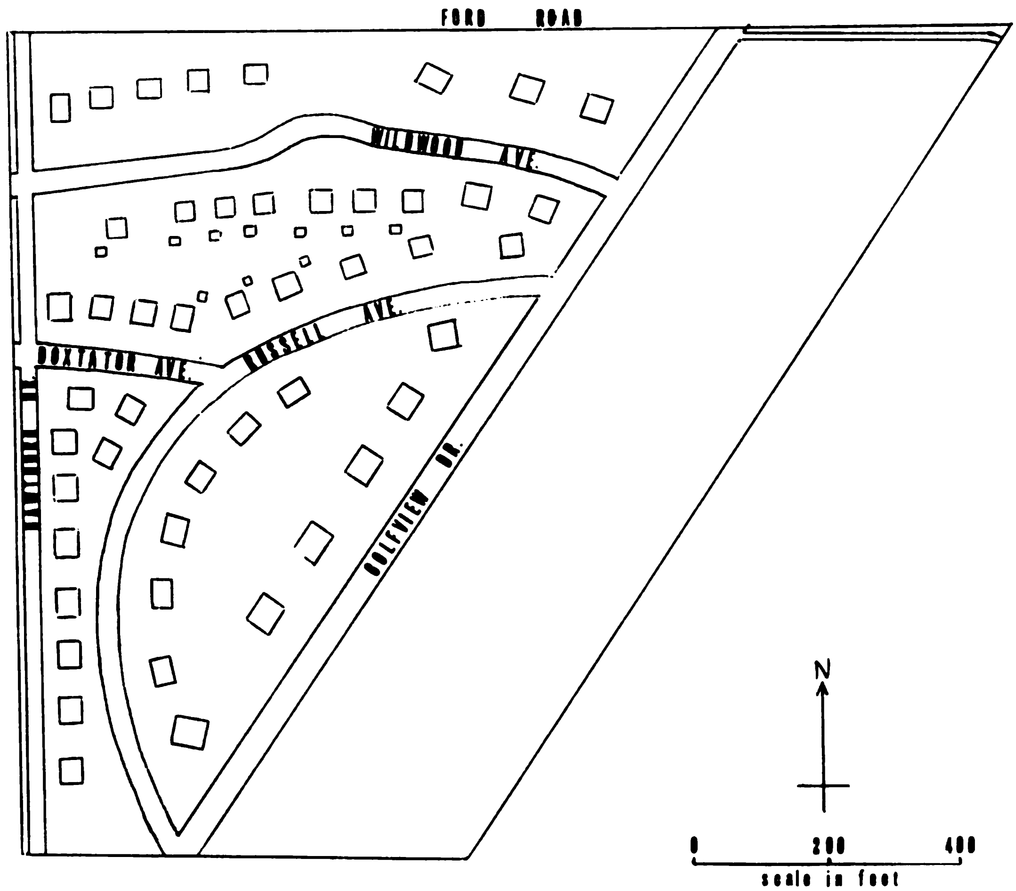

Figure 11. Golfview study area.

Figure 12. Golfview residential subsection.

With the exception of some shrubs along Ford Road, all plantings were well trimmed and presented a neat appearance. A complete listing of trees and shrubs in the area is found below (Appendix A, Table 7).

Park Subsection

A 13.64-acre section of the Dearborn Country Club was selected for study. The area is typical of a golf-course setting, except that along the northern edge of the study area there is a three-quarter-acre strip of hawthorn; this area is very dense in contrast to the rest of the golf course (Figure 13). The remaining 12.89 acres is quite open in appearance. The major tree plantings are groves of American elm which are generally 55 to 60 feet in height. More recent plantings of various species of pine, oak, and maple are also present, but these consist of scattered individuals which range from 10 to 15 feet in height. There are no shrubs planted on the golf course itself. (For a complete listing of trees and shrubs, see Appendix A, Table 8).

Dearborn Area

The Dearborn study area contains 27.35 acres. The residential subsection of this area is bordered on the north by West Lane, on the east and south by the wooded park subsection, and on the west by an open field (Figure 14). The park subsection of the Dearborn area is continuous with the Rouge River Parkway System. This parkway system is largely wooded and extends from the edges of the metropolitan Detroit area to Michigan Avenue in Dearborn. The residential subsection was subdivided about 15 years ago, and all but two lots now have houses on them.

Figure 13. Golfview park subsection.

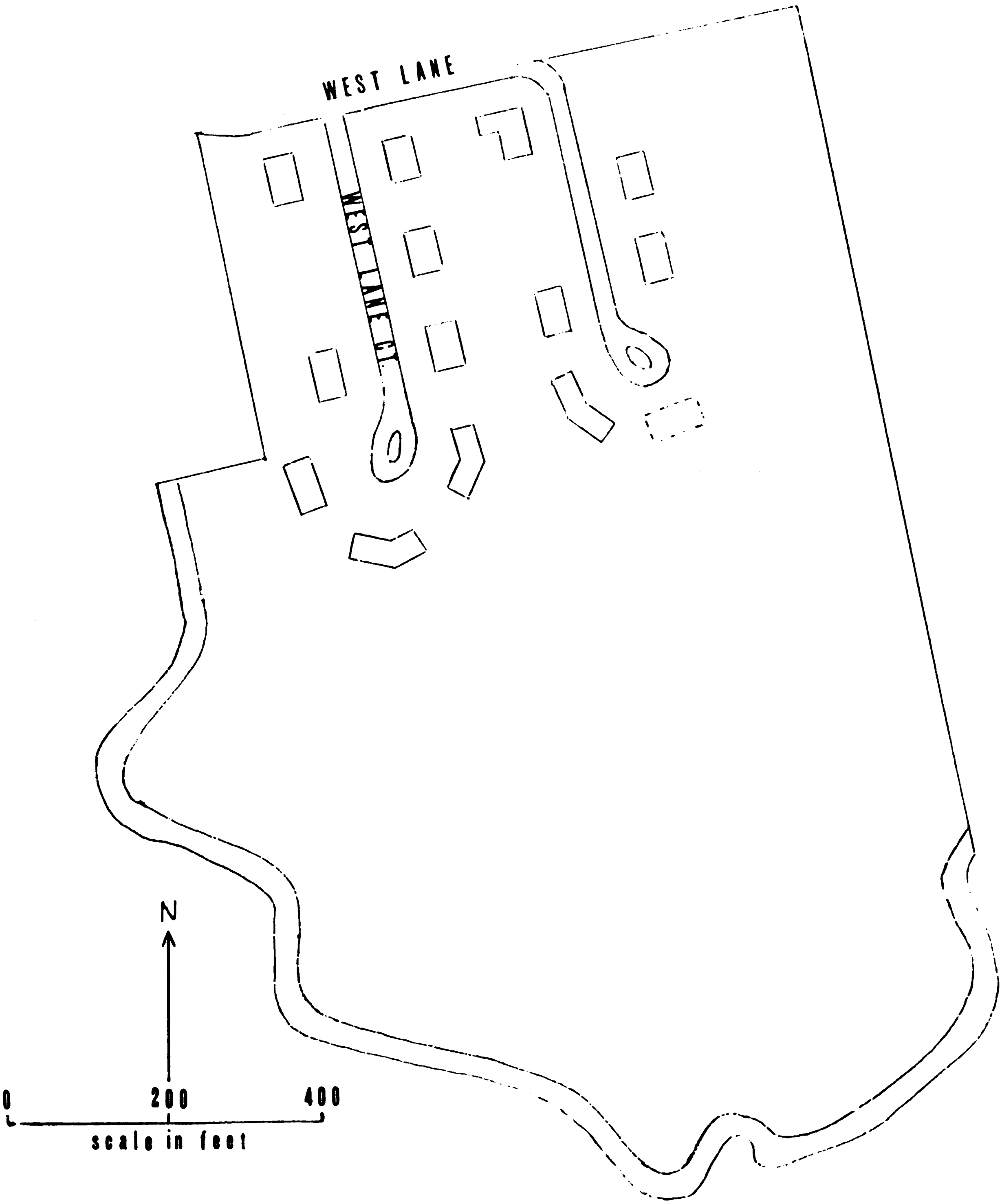

Figure 14. Dearborn study area.

Residential Subsection

There are 13 houses located on the residential subsection of the Dearborn area; an additional house was being constructed during the period of study. Lots vary in size, but are generally 150 feet by 150 feet. Houses are equally divided between ranch houses and two-story structures; both brick and wood were used in construction (Figure 15). All houses are well-kept, with most residents hiring people to care for their house and grounds. Residents of this neighborhood are in large part medical doctors and executives of the Ford Motor Company.

Many of the trees located in this study area are remnants of the original vegetation; these include white ash, box elder, and species of oak, pine, and hawthorn. Many other species of trees were planted as well, giving this area the greatest number of tree species of the five study areas. Shrubs are also very diverse, largely because the affluence of the residents enables them to have their yards professionally landscaped. A complete listing of trees and shrubs occurring in this area is found below (Appendix A, Table 9).

Park Subsection

The park subsection of the Dearborn study area is made up of two vegetative types and is 19.50 acres in size. Vegetation on the higher ground bordering the residential subsection is primarily hawthorn. Coverage of the tree strata is approximately 50 percent, which allows ample light to reach the ground and foster a thick herbaceous growth (Figure 16). On the lower ground bordering a stream, the hawthorn gives way to box elder and black ash. This wooded area has an overstory

Figure 15. Dearborn residential subsection.

Figure 16. Dearborn park subsection.

whose height ranges from 40 to 50 feet; there is essentially no intermediate stratum. Ground cover primarily consists of stinging nettles. A complete listing of trees and shrubs is given below (Appendix A, Table 10).

METHODS

General

During the initial phases of this project, ten potential study sites were selected within the metropolitan Detroit area; these sites were chosen on the basis of information supplied by the Southeastern Michigan Council of Governments and by the examination of aerial photographs. Both areial and ground reconnaissance was used to select the five areas to be studied intensively. These five study areas were chosen on the basis of the neighborhood, the economic level of the residents, the general status of the vegetation present, and the type of park immediately bordering the residential section of the area.

Vegetative Analysis

Residential Subsections

Within each residential area, yards were selected as the basic unit to be analyzed. Each house was numbered, and those to be analyzed were chosen from a table of random numbers (Rohlf and Sokal, 1969). Alternative houses or plots were chosen in case access could not be gained to one of the primary plots. Within those study areas which were relatively uniform, a smaller percentage of the houses was measured than in those areas which were more complex. The percent of yards measured in the Clark, Woodmere, Ford, Golfview, and Dearborn study areas was 13.48, 9.14, 12.63, 23.40, and 38.46, respectively.

The volume of the crown of every tree present in each of the yards selected for intensive study was determined in the following

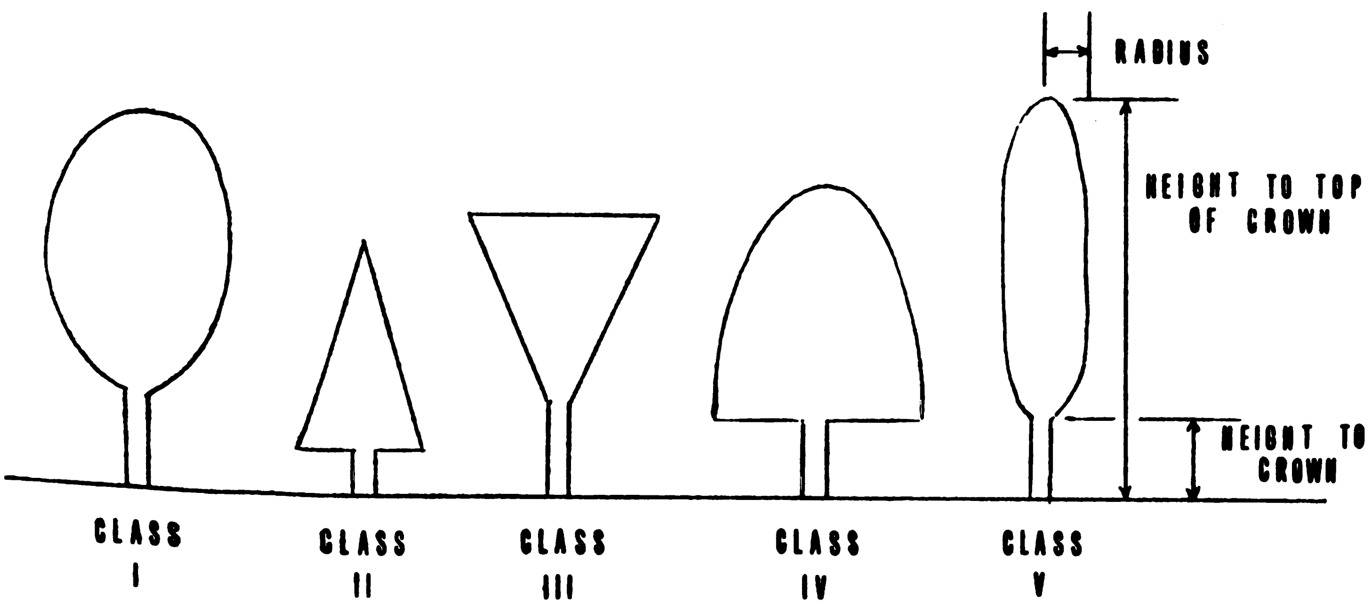

Figure 17. Crown classification and measurements.

manner. First, the crown profile class of the tree was recorded. Five crown profile classes were used (Figure 17); these represent the basic shapes of all the trees encountered during the study. Next, the radius of the tree was measured. Each tree was assumed to be circular in horizontal cross section; in those cases where a tree was not circular, an average radius was used. The overall height of the tree and the height to the bottom of the crown were then determined by using a Haga altimeter (Figure 17). The volume of the crown of each tree was calculated from these field data by using a computer program developed specifically for this project by Mr. Allen Tipton.

The diameter at breast height, the leaf density class, and species of each tree were also measured. Leaf density was divided into three classes: dense, moderate, and sparse. Those trees which were classified as dense showed little or no light penetration through the surface of the crown. A plant with moderate leaf density had numerous small openings throughout the crown, and a tree classified as sparse had widely separated leaves. Each tree was also recorded as being deciduous or coniferous.

The volume of each shrub located on the study plots was calculated by visually reducing the shape of the plant to a box. The leaf density and ground cover of each shrub were also recorded. The leaf density class was defined as above; ground cover was classified as complete, partial, or none. Complete ground cover was defined by a continuous or nearly continuous mass of stems and leaves. A shrub which was classified as having partial ground cover had numerous scattered openings in the leaf and stem cover, while "none" indicated that there was essentially no stem or leaf cover at ground level. Finally, it was noted whether a shrub was deciduous or coniferous.

Additional data gathered on each plot included the area of lawn, the area of herbaceous growth, the area of bare ground, the area of concrete, the area of garden, the area and volume of each building, and various architectural features of the buildings present. These architectural features included the type of eaves present, roof type, and building type. Eaves were classified in the following manner: no eave, boxed eave, and open eave. Roofs were noted as being either flat or sloped, and buildings were classified as business, dwelling, apartment, garage, out building, or other. Openings in buildings which could be used by birds as entrances to nest sites were also noted.

Park Subsections

The same information, where applicable, was gathered in the park subsections as was gathered in the residential subsections. In the Clark area three-fourths of the park was analyzed to determine the species composition, density, and basal area of the trees which were present. Crown volumes were determined in the same manner as in the residential subsections, except that the trees to be measured were selected along a transect. Trees were selected using the point-centered quarter method (Ohmann and Ream, 1971), with points being 100 feet apart. This distance proved to be far enough so that the same tree was not sampled twice. All shrubs present in the park subsection of the Clark study area were measured as described above (see Residential Subsections). Areas of grass and concrete were also measured. One small maintenance building was present at the southwest corner of the park; its area and volume were recorded.

The park subsection of the Woodmere study area was measured in a manner similar to that of the Clark area, except that all trees present were measured to determine species composition, density, and basal area.

The park subsection of the Ford study area was analyzed using a method similar to that described by Ohmann and Ream (1971). Trees from both the upper and intermediate strata were sampled using the point-centered quarter method, as was the vegetation in the shrub layer. The measurements taken were the same as those previously described (see Residential Subsections). Sapling cover and ground cover were measured in milacre and two by two-foot plots, respectively. Ground cover was classified as herbaceous, bare ground, wood (dead and/or alive), water, and other.

The park subsection of the Golfview study area was divided into two parts for the purposes of vegetative analysis. The larger part was a golf course, while the smaller area was shrubby in nature. A complete analysis of all vegetation was made on the golf course using the methods which have been previously described (see Residential Subsections). The smaller section of the park was a dense stand composed primarily of hawthorn with some overstory trees. Two 25 by 25-foot plots were used to measure the pertinent features of the lower story vegetation and ground cover. All trees in the overstory were analyzed.

The park subsection of the Dearborn study area was measured by using two quarter-acre plots located in vegetation which was typical of the area. All trees, including saplings and shrubs, within each quarter-acre plot were measured as was described above (see Residential Subsections). Ground cover was measured in ten two by two-foot subplots which were spaced at ten-foot intervals along the western edge of each quarter-acre plot. The ground cover characteristics which were noted were the same as those described above (see Park Subsections, Ford study area).

Bird Surveys

Table 1 lists the number of bird surveys conducted in each study area during 1972 and 1973 by season and time of day. During the spring and early summer of 1972, bird censuses started on April 10 and ended on July 29. The fall surveys were carried out during the second week of October and the second week of November. The winter bird surveys were conducted during the first and third weeks of January, 1973. The second spring and early summer surveys began on April 18 and ended on July 12, 1973.

During the first year of study, evening bird censuses were made approximately once every three weeks. These were conducted primarily in an effort to identify certain species which might be more active during that time of day. Only one evening survey was conducted during 1973. As is described below, a different survey technique was used during the second year of study. Since this method did not lend itself to an evening census (see Comparison of Bird Survey Techniques), and since sufficient census data was available from the previous year, evening bird surveys were not continued during the second year.

During both years of study, all morning bird censuses were begun approximately one half-hour after sunrise (5:30-6:00 A.M. EST) and were concluded by 10:00 A.M. EST. The order in which the study areas were censused was rotated each week to avoid a time bias between areas. Evening censuses began at approximately 5:00 P.M. EST and ended a half-hour before sunset (7:30-8:30 P.M. EST).

Table 1. Number of bird surveys conducted in each study area.

	1972 Spring-Summer		Fall	Winter	1973 Spring-Summer	
Study Area	Morning	Evening	Morning	Morning	Morning	Evening
Clark	16	5	1	2	12	1
Woodmere	16	5	1	2	12	1
Ford	15	5	1	2	13	1
Golfview	16	6	2	2	12	1
Dearborn	14	3	2	2	11	1

During the first year of study, an attempt was made to survey all of each study area every week. Accordingly, transects which allowed total visual surveillance of the area were established through each study plot. Alleys permitted visual access to backyards in the Clark and Woodmere study areas, while backyards in the Golfview and Dearborn areas could be seen from streets or from the park subsection. Only in the Ford study area was it difficult to see into some of the backyards; however, by looking into backyards from cross streets and by sampling selected backyards, nearly all of this area was censused.

In an attempt to overcome problems in sampling, a time-area method of bird censusing was used during the fall (1972) and winter (1973) surveys, at which time it was perfected. This method was also utilized during the spring-summer surveys of 1973. A table of random numbers (Rohlf and Sokal, 1969) was used to select ten sampling points each week in each study area. The number of points located in each subsection of each study area was roughly proportional to the amount of land that each occupied and was further adjusted to correct problems of visibility. Thus, seven points were located in the residential subsections of the Clark, Woodmere, Ford, and Golfview areas, while only two were placed in the residential subsection of the Dearborn study area. At each point approximately three-fourths of an acre (a circle with a radius of 100 feet) was sampled. In the residential subsections of the Clark and Woodmere study areas, yard borders were used to establish censusing areas. Since visibility was limited by the closely-spaced houses in these two areas, 150-foot square plots were used to sample the bird population. This size plot represents five 30-foot lot widths in each of these areas, so plot size was easily established in the field. Five minutes were spent at each census point. It was felt that this time period was sufficient to allow any disturbance caused by movement of the observer to subside.

Bird Species Diversity Index

All species and all individuals of each species were tallied during every census so that a bird species diversity index could be computed (MacArthur and MacArthur, 1961); this index permits a comparison of the diversity of each of the study areas. In making this comparison, the higher the index, the higher the bird species diversity. In a population with a given number of species, the measure of diversity will be maximum when all species are present in equal proportions (equitability component). It is also true that given two populations in which the species are evenly represented, the population with the larger number of species will have the higher diversity (species richness component) (Pielou, 1969; Kricher, 1972). The formula used to compute the diversity index may be expressed as follows:

$$\text{Bird Species Diversity} = -\sum_i p_i \log_e p_i$$

where p is the proportion of birds in the i^{th} species.

Statistical Analysis

A least squares stepwise regression program available through the Michigan State University Computer Science Center was used to analyze the relationship between the eight dependent variables (bird species diversity, Table 2; the population levels of seven selected species, Table 4) and the 33 independent variables (Table 16); this procedure was used within the residential subsections. This procedure starts by calculating a simple correlation matrix between all variables and then entering the independent variable most highly correlated with the dependent variable under consideration into regression. The next independent variable to enter the regression is the one whose partial correlation coefficient is the highest. At this point, and after the entrance into regression of any additional independent variables, all variables are reexamined to determine what their contribution would be if they had been entered in a different order. If an independent variable does not meet the statistical criterion (a significance of .05 in this study), it is rejected. The least squares stepwise procedure then continues until no more independent variables meet the statistical qualifications.

Additional statistical procedures which were utilized in the data analysis are discussed where appropriate.

Questionnaire

In order to acquire information about the people living in each of the study areas, it was necessary to distribute a questionnaire (see Appendix B, Figure 2). This questionnaire was designed to gain an insight into the habits of the residents which might affect the birdlife of their neighborhood. It also sought to determine the attitudes of these people toward the birds around them. An introductory letter was given to each person who was surveyed (see Appendix B, Figure 1).

Households to be interviewed were chosen by a table of random numbers (Rohlf and Sokal, 1969). Additional numbers were chosen as alternatives to the primary selections. In spite of this, Mr. James Longley, who distributed the questionnaire, found it necessary to choose additional houses. Each household selected to be interviewed was given a letter of introduction one week before the survey took place. All residents were interviewed in the evening hours in order to eliminate a bias toward housewives.

Although it is typical to inquire into the educational and financial background of persons being interviewed, it was felt that in the present study residents might look upon this as an invasion of their privacy; it was therefore decided to inquire about their occupation (see Appendix B, Figure 2). Because of the diverse range of occupations encountered, residents were grouped into several broad categories (i.e., professional, non-professional, housewife, student, and retired). Professional workers were those persons who hold jobs which generally require a college education (e.g., doctor, lawyer, executive); non-professional workers did not require such an education (e.g., steel worker, store clerk).

BIRD SPECIES DIVERSITY

General

Bird species diversity was calculated for every observation period in each subsection of all study area; this information is presented graphically in Figures 18 through 21. The mean bird species diversity, standard deviation, and coefficient of variation for each study area are presented in Table 2. The Student-Newman-Keuls procedure (Sokal and Rohlf, 1969) was used to test for a significant difference (α = .05; V = 60 for 1972 and 55 for 1973) between the means of each area; these data are presented in Table 3. Statistical comparisons between years are not possible because a different method of gathering data was used each year (see Methods).

The total number of avian species seen in each subsection during each year is presented in Table 4 (also see Appendix E). This table shows that more species were generally seen in the park subsections than in the residential areas. The Woodmere residential subsection had the fewest number of species, while the Dearborn park subsection had the greatest number.

Residential Subsections

There appeared to be little difference in bird species diversity between years in the residential subsections (Figures 18 and 19; Tables 2 and 3). Although the difference in the Clark study area was larger than in any of the other study areas, it is probable that it can be accounted for by yearly variations in weather and methodology.

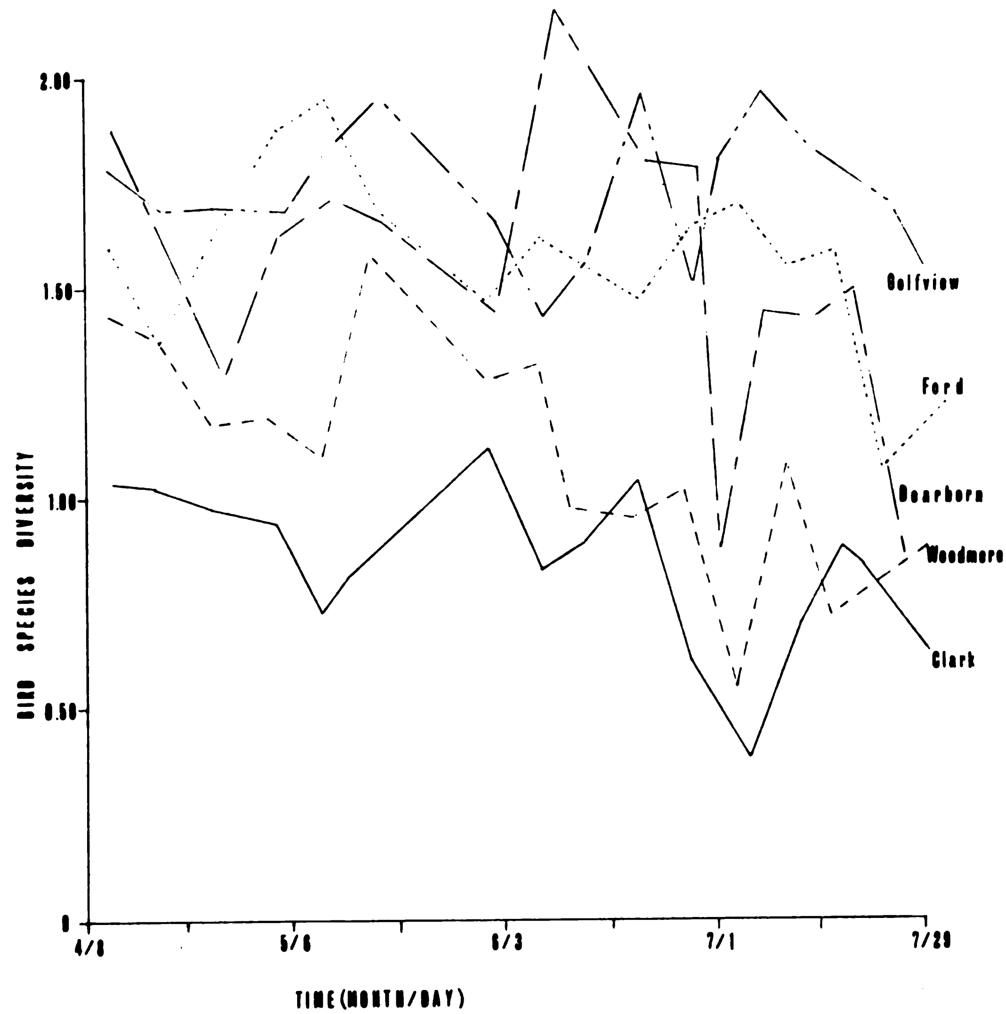

Figure 18. Weekly variation in bird species diversity within the residential subsections (1972).

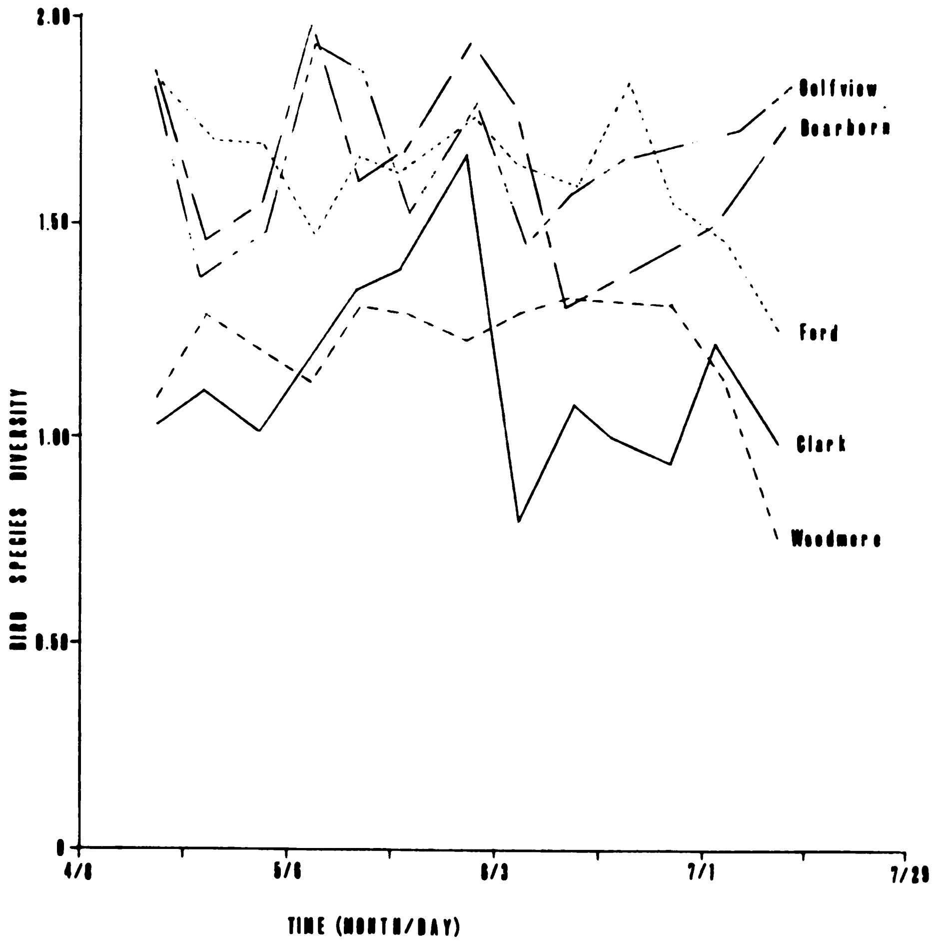

Figure 19. Weekly variation in bird species diversity within the residential subsections (1973).

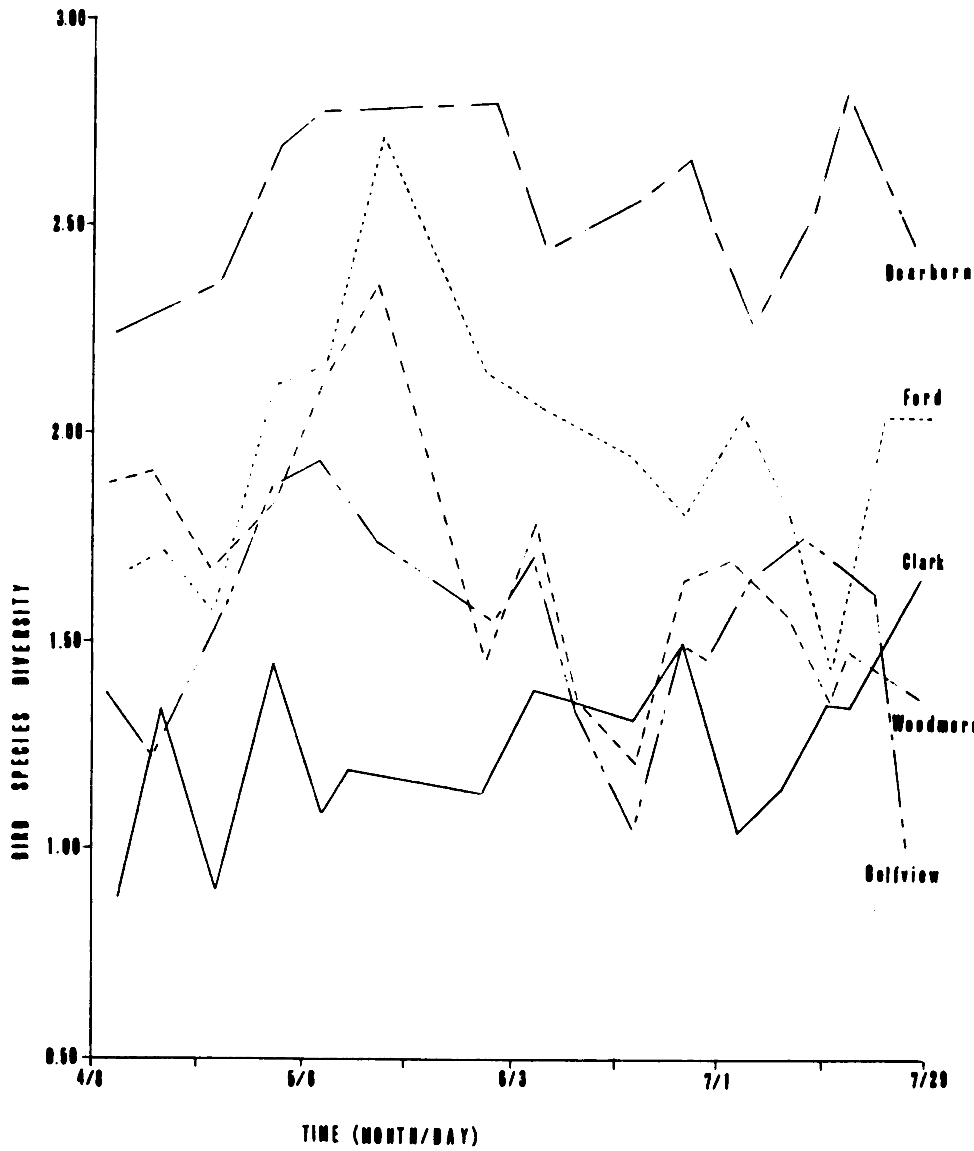

Figure 20. Weekly variation in bird species diversity within the park subsections (1972).

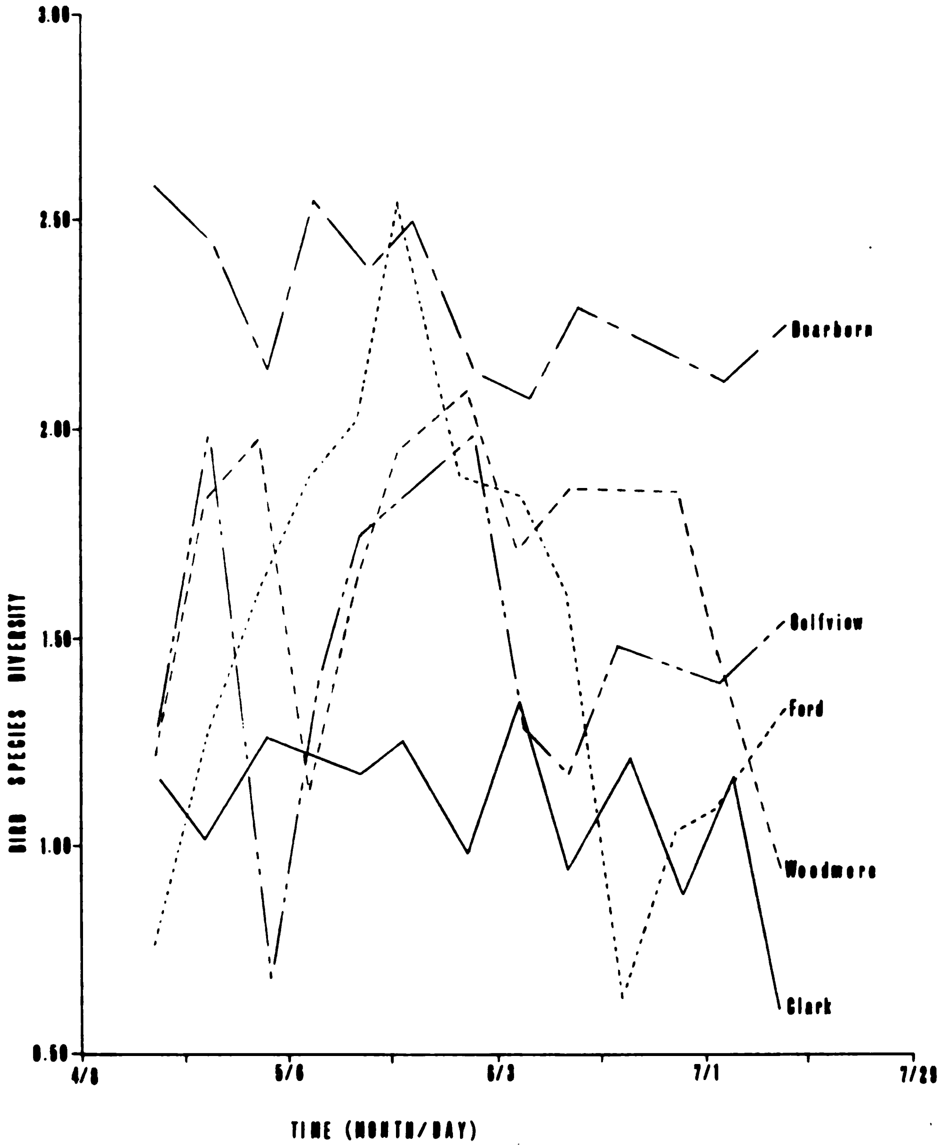

Figure 21. Weekly variation in bird species diversity within the park subsections (1973).

Table 2. Mean bird species diversity during 1972 and 1973 for both residential and park subsections.

	1972			1973		
	$\overline{Y}$*	S.D.**	C of V***	$\overline{Y}$	S.D.	C of V
Residential Subsection						
Clark	.85676	.20201	23.58	1.14305	.24407	21.35
Woodmere	1.11640	.27203	24.37	1.23104	.18446	14.98
Ford	1.64215	.16858	10.27	1.62545	.16449	10.12
Golfview	1.72779	.22961	13.29	1.67452	.18508	11.05
Dearborn	1.57404	.31513	20.02	1.67766	.21441	12.78
Park Subsection						
Clark	1.24845	.17542	14.05	1.09837	.20156	18.35
Woodmere	1.68773	.32091	19.01	1.64210	.36645	22.32
Ford	1.87252	.45200	24.14	1.51427	.54667	36.10
Golfview	1.56597	.24969	15.94	1.41756	.38097	26.88
Dearborn	2.59264	.18356	7.08	2.31197	.18481	7.19

* Mean bird species diversity.

** Standard deviation.

*** Coefficient of variation.

Table 3. Significant difference in bird species diversity means.

1972 Residential					1972 Park				
Clark	Woodmere	Dearborn	Ford	Golfview*	Clark	Golfview	Woodmere	Ford	Dearborn

1973 Residential					1973 Park				
Clark	Woodmere	Ford	Golfview	Dearborn	Clark	Golfview	Ford	Woodmere	Dearborn

* Underline indicates populations that are not significantly different ($\alpha = .05$).

Table 4. Total number of avian species seen in each study area during 1972 and 1973.

	1972		1973	
Study Area	Residential	Park	Residential	Park
Clark	16	16	16	8
Woodmere	12	31	13	19
Ford	22	42	15	33
Golfview	26	29	21	20
Dearborn	28	52	20	40

During both years of study, the mean bird species diversity of the Clark and Woodmere areas was significantly lower than that of the Ford, Golfview, and Dearborn areas, although during 1973 the former two were not significantly different from each other ($\alpha = .05$) (Table 3). These differences in diversity were primarily the result of differences in the evenness with which the number of birds was distributed among the species, with the possible exception of the Woodmere area (Table 4). Use of the Student-Newman-Keuls test further revealed that the Ford, Golfview, and Dearborn study areas were not significantly different from each other in 1973; in 1972, although the Golfview and Dearborn areas were significantly different from each other, they were not significantly different from the Ford area.

The influx of migratory species appeared to have little or no effect on bird species diversity. Although the May 31, 1973, peak in bird species diversity in the Clark area roughly coincides with the migratory season, it did not occur as a result of it. This peak was primarily caused by the high equitability component of the bird species diversity index. As was noted earlier (see Methods), the higher the value for equitability, the more even the dispersion of the number of individual birds among the number of species. During the month of May when bird species diversity was increasing, the number of species was about the same as before; therefore, an increase in the equitability component was primarily responsible for the increase in the diversity index. After May 31, 1973, there was a large drop in the equitability component and a concomitant drop in the bird species diversity index itself. That the 1973 peak was not caused by an influx of migrants is further demonstrated by the fact that only three warblers were seen during May, 1973, in the Clark area.

Although none of the residential subsections showed a seasonal increase which could possibly be the result of an influx of migrants, there was a downward trend in bird species diversity in each study area toward the end of the study period both years. This trend was most noticeable in the Clark, Woodmere, and Ford study areas, and was caused largely by a drop in both the equitability component and in the number of species seen. It seems likely that this drop resulted from birds becoming less conspicuous as the summer progressed.

The coefficient of variation was highest in the Clark, Woodmere, and Dearborn areas (Table 2). In the first two study areas this was caused by the seasonal variation discussed above. In the case of the Dearborn area, the small size of the area itself and the limited number of sample points in 1973 were primarily responsible for the high variation.

Park Subsections

As was the case in the residential subsections, the variation in bird species diversity between years in the park subsections was not appreciable, and in both years the diversity index followed the same trends (Figure 20 and 21). It can be seen in Table 1 that the mean 1973 bird species diversity of every study area was slightly lower than the same value for 1972. As was also the case in the residential subsections, it is felt that this variation between years largely reflects differences in weather and methodology. It is possible, however, that in 1973 there was a real difference in the period of migration; during 1973 the peak migratory period (as reflected by both the bird species diversity index and observation) occurred about one week later than it did in 1972 (Figure 20).

In 1972 the mean bird species diversity was significantly different in each of the five park subsections (Figure 20). In 1973, however, the Clark and Golfview areas were not significantly different from each other, but the Woodmere, Ford, and Golfview areas were; the Dearborn study area was significantly different from each of the other areas. Unlike the residential areas, there were fairly large differences in the number of species seen in each park (Table 4). Methodology was primarily responsible for the difference between the significance levels in 1972 and 1973; in 1972 sampling was more intensive in the park subsections than it was in 1973 (see Methods).

Unlike the residential subsections, the park areas did experience a seasonal variation in bird species diversity which was caused by the influx of migratory species. This is demonstrated very well for the Ford area in both 1972 and 1973 and for the Woodmere and Golfview areas in 1972. The 1973 data show a decline during May in the latter two areas which was caused in large part by adverse weather conditions. Therefore, the seasonal variation in these areas gives little meaning to the mean bird species diversity values in Table 2. Considering the weekly variation in the diversity index, migratory species had no apparent effect in the Clark and Dearborn areas (Figures 20 and 21). In the Dearborn area, however, many migratory species were observed, but because of the high number of resident species, they had little impact on the index.

The coefficient of variation was highest in the Ford, Woodmere, and Golfview areas (Table 2); this was a result of the effect of migrants on the bird species diversity index. In 1973 the coefficient of variation was consistently higher than it was in 1972, which was a direct result of the difference in methodology between years. During 1973 the effect of increased sampling points on the coefficient of variation is demonstrated in the Dearborn area, where a very low value was recorded (Table 2).

SPRING-SUMMER BIRD SURVEYS

Introduction

During this study, average population estimates (birds per acre) were calculated for the total resident bird population as well as for seven selected species (house sparrow, starling, robin, grackle, blue jay, cardinal, and dove) in each of the study areas each year (Tables 5 and 6). The significance of the difference in the mean bird population estimates ($\alpha = .05$; $V = 60$ for 1972 and 55 for 1973) between study areas was calculated by using the Student-Newman-Keuls procedure (Sokal and Rohlf, 1969) (Tables 7 through 14). Table 7 also contains the percent of the total population which is represented by the sum of the seven selected species, while Tables 8 through 14 contain the percent of the total population represented by each individual species in each study area. Estimates of migratory bird populations were also calculated in order to determine the relationship of their numbers to the total resident population (Table 15).

The data presented in Tables 5 and 6 shows that there is a fairly large difference between the 1972 and 1973 population estimates for both total and individual bird populations. It is probable that this variation in the yearly population estimates primarily reflects the difference in survey techniques (see Methods) rather than being the result of a real difference in bird population levels. This is substantiated by the fact that there was, for all practical purposes,

Table 5. 1972 and 1973 population estimates for the total bird population and seven selected species of the residential subsections.

Area	Total Population	House Sparrow	Starling	Robin	Grackle	Blue Jay	Cardinal	Mourning Dove
Clark	5.87*±1.857**	4.49±1.731	.704±.555	.145±.122	.133±.195	.005±.02	0	.032±.100
Woodmere	5.12±1.278	3.38±1.165	.442±.261	.217±.152	.272±.179	.148±.179	0	.032±.447
Ford	4.77±1.277	1.98±.705	.409±.190	.697±.382	.858±.435	.350±.184	.063±.134	.278±.126
Golfview	4.39±1.107	1.83±.567	.573±.338	.541±.182	.660±.464	.203±.237	.185±.110	.213±.134
Dearborn	3.73±.826	1.96±.779	.094±.114	.278±.740	.440±.293	.129±.182	.059±.071	.200±.105
				1973				
Clark	9.18±1.708	5.67±1.118	1.83±1.336	.47±.438	.150±.207	.083±.126	.041±.095	.048±.110
Woodmere	9.95±1.829	5.55±1.118	2.40±1.367	.44±.362	.440±.540	.250±.281	0	.070±.134
Ford	11.87±4.536	4.47±1.916	1.52±1.642	.89±.480	2.06±1.088	.899±.677	.280±.259	.824±.358
Golfview	9.90±2.593	3.98±1.153	1.11±.843	.99±.603	1.47±1.170	.630±.316	.250±.230	.676±.602
Dearborn	8.48±2.503	2.60±1.187	.77±1.139	.63±.576	1.45±1.060	.340±.471	.200±.502	.790±.703

* All values per acre.

** Standard deviation of mean.

Table 6. **1972 and 1973 population estimates for the total population and** seven selected species of **the park subsection.**

Area	Total Population	House Sparrow	Starling	Robin	Grackle	Blue Jay	Cardinal	Mourning Dove
				1972				
Clark	5.21±3.815 * **	1.05±.677	1.268±1.108	.128±.358	.834±1.707	.035±.045	.09±.032	.035±.063
Woodmere	2.28±.871	.14±.283	.555±.399	.234±.484	.466±.596	.113±.182	0	.105±.084
Ford	2.77±1.062	.17±.310	.532±.520	.284±.533	.458±.613	.275±.212	.284±.207	.073±.385
Golfview	1.87±.329	.075±.105	.102±.114	.269±.519	.512±.428	.032±.055	.059±.084	.065±.105
Dearborn	3.90±1.148	.069±.089	.279±.285	.173±.416	.434±.354	.165±.110	.454±.292	.121±.084
				1973				
Clark	9.60±3.572	1.81±1.196	5.17±1.281	.387±.436	.58±1.120	.04±.126	0	0
Woodmere	6.33±2.985	.73±1.034	1.54±1.780	.657±.503	.733±1.054	.463±.624	0	.384±.386
Ford	5.24±3.961	.18±.400	1.46±2.387	.107±.277	.57±1.138	.749±.815	.499±.582	.106±.202
Golfview	5.36±2.239	.038±.130	.386±.553	.347±.447	1.427±1.359	.154±.342	.077±.179	.308±.362
Dearborn	7.00±2.637	.063±.118	.820±1.282	.142±.187	1.293±.885	.377±.327	.646±.361	.346±.411

* **All values per acre.**

** Standard deviation of mean.

Table 7. **Significant difference of means of total bird population estimates.**

1972 Residential					1972 Park				
Dearborn	Golfview	Ford	Woodmere *	Clark	Golfview	Woodmere	Ford	Dearborn	Clark
84.72**	95.79	97.17	87.71	93.85	59.57	70.75	76.04	43.46	66.03

1973 Residential					1973 Park				
Dearborn	Clark	Golfview	Woodmere	Ford	Ford	Golfview	Woodmere	Dearborn	Clark
79.95	87.47	91.98	91.96	92.19	70.06	51.06	71.20	52.67	83.20

* Underline indicates populations that are not significantly different (α = .05).

** Percent of total population accounted for by seven selected species.

Table 8. Significant difference of means of house sparrow population estimates.

1972 Residential

Golfview	Dearborn	Ford *	Woodmere	Clark
41.69**	52.55	41.51	66.02	76.49

1972 Park

Dearborn	Golfview	Woodmere	Ford	Clark
1.77	4.01	6.14	6.23	20.15

1973 Residential

Dearborn	Golfview	Ford	Woodmere	Clark
30.66	40.20	37.66	55.78	59.81

1973 Park

Golfview	Dearborn	Ford	Woodmere	Clark
.71	.90	3.44	11.53	18.85

* Underline indicates populations that are not significantly different (α = .05).

** Percent of the total population represented by this species.

Table 9. Significant difference of means of starling population estimates.

1972 Residential

Dearborn	Ford	Woodmere	Golfview	Clark *
2.52**	8.57	8.63	13.05	11.99

1972 Park

Golfview	Dearborn	Ford	Woodmere	Clark
5.45	7.15	19.49	24.34	24.34

1973 Residential

Dearborn	Golfview	Ford	Clark	Woodmere
9.08	11.21	12.81	19.30	24.12

1973 Park

Golfview	Dearborn	Ford	Woodmere	Clark
7.20	11.71	27.86	24.33	53.85

* Underline indicates populations that are not significantly different (α = .05).

** Percent of the total population represented by this species.

Table 10. **Significant difference of means of robin population estimates.**

1972 Residential

Clark	Woodmere	Dearborn	Golfview	Ford *
2.47**	4.24	7.45	12.32	14.61

1972 Park

Clark	Dearborn	Woodmere	Golfview	Ford
2.46	4.44	10.26	14.39	10.40

1973 Residential

Woodmere	Clark	Dearborn	Ford	Golfview
4.42	4.96	7.43	7.50	10.00

1973 Park

Ford	Dearborn	Golfview	Clark	Woodmere
2.04	2.03	6.47	4.03	10.38

* Underline indicates populations that are not significantly different (α = .05).

** Percent of the total population represented by this species.

Table 11. Significant difference of means of grackle population estimates.

1972 Residential

Clark	Woodmere	Dearborn	Golfview	Ford *
2.27**	5.31	11.80	15.03	17.99

1972 Park

Dearborn	Ford	Woodmere	Golfview	Clark
11.13	16.78	20.44	27.38	16.01

1973 Residential

Clark	Woodmere	Dearborn	Golfview	Ford
1.58	4.42	17.10	14.85	17.35

1973 Park

Ford	Clark	Woodmere	Dearborn	Golfview
10.88	6.04	11.58	18.47	26.62

* Underline indicates populations that are not significantly different (α = .05).

** Percent of the total population represented by this species.

Table 12. Significant difference of means of blue jay population estimates.

1972 Residential

Clark	Dearborn	Woodmere	Golfview	Ford
.09**	3.46	2.89	4.64	7.34

1972 Park

Golfview	Clark	Woodmere	Dearborn	Ford
1.71	.67	4.96	4.23	10.07

1973 Residential

Clark	Woodmere	Dearborn	Golfview	Ford
.88	2.51	4.01	6.36	7.57

1973 Park

Clark	Golfview	Dearborn	Woodmere	Ford
.42	2.87	5.39	7.31	14.29

* Underline indicates populations that are not significantly different ($\alpha = .05$).

** Percent of the total population represented by this species.

Table 13. **Significant difference of means of cardinal population estimates.**

1972 Residential

Clark	Woodmere	Dearborn	Ford	* Golfview
0**	0	1.58	1.32	4.21

1972 Park

Woodmere	Golfview	Clark	Ford	Dearborn
0	3.16	1.73	10.40	11.64

1973 Residential

Woodmere	Clark	Dearborn	Golfview	Ford
0	.43	2.36	2.53	2.36

1973 Park

Clark	Woodmere	Golfview	Ford	Dearborn
0	0	1.44	9.52	9.23

* **Underline indicates populations that are not significantly different (α = .05).**

** **Percent of the total population represented by this species.**

Table 14. Significant difference of means of mourning dove population estimates.

1972 Residential

Clark	Woodmere	Dearborn	Golfview	Ford *
.55**	.63	5.36	4.85	5.83

1972 Park

Clark	Golfview	Ford	Woodmere	Dearborn
.67	3.48	2.67	4.61	3.10

1973 Residential

Clark	Woodmere	Golfview	Dearborn	Ford
.51	.70	6.83	9.32	6.94

1973 Park

Clark	Ford	Golfview	Dearborn	Woodmere
0	2.02	5.75	4.94	6.07

* Underline indicates populations that are not significantly different (α = .05).

** Percent of the total population represented by this species.

Table 15. Comparison of resident and migratory bird populations.

Population	Clark	Woodmere	Ford	Golfview	Dearborn
		1972 Residential Subsections			
Resident	5.87*	5.12	4.77	4.39	1.87
Migratory	.02	0	.03	.03	.06
Percent of the total that are migratory	.34	0	.63	.68	3.11
		1973 Residential Subsections			
Resident	9.48	9.95	11.87	9.90	8.48
Migratory	.08	.04	.05	.09	.26
Percent of the total that are migratory	.84	.40	.42	.90	2.97
		1972 Park Subsections			
Resident	5.21	2.28	2.96	1.87	3.90
Migratory	.02	.02	.25	.06	.22
Percent of the total that are migratory	.38	.87	7.79	3.11	5.34
		1973 Park Subsections			
Resident	9.60	6.33	5.24	5.36	4.32
Migratory	.09	.23	.68	.04	.39
Percent of the total that are migratory	.93	3.51	11.49	.74	8.28

* Birds per acre.

no change in either the vegetative or physical composition of the study areas between 1972 and 1973. Thus, although bird populations could be expected to vary slightly between years, it is unreasonable to assume that they would change as much as is indicated in Tables 5 and 6. It seems feasible that the actual population level lies somewhere between those which were calculated.

The seven individual birds selected for detailed analysis were chosen using the following criteria: they were either very popular or unpopular with residents of the study areas, they were present in all of the study areas, and/or they represented an important segment of the total bird population.

Residential Subsections

The 1972 population estimates of the total bird population ranged from 3.73 birds per acre in the Dearborn subsection to 5.87 birds per acre in the Clark subsection. In 1973 total bird population estimates ranged from 8.48 birds per acre in the Dearborn area to 11.87 birds per acre in the Ford area. These figures compare favorably with those calculated by Woolfenden and Rohwer (1969) for three Florida suburbs and by Smith (1971) for four residential sections of Reston, Virginia. Population estimates for the present study show that the total bird population in the Dearborn area was lower than that of any other residential subsection. It should be pointed out, however, that the total bird population in the Dearborn area was significantly lower than only that of the Clark area in 1972 and than that of the Ford area in 1973 (Table 7). Table 7 further shows that in 1972 the only other pair of areas to have significantly different total bird populations were the Clark and Golfview subsections. In 1973 there was no combination of areas, other than those mentioned above, in which the total bird populations were significantly different from one another. Thus, it appears that although the total bird population of any one residential area may vary from that of any other, the difference between them is not likely to be significant.

It was found that the seven selected species made up not less than 80 percent of the total bird population of any residential subsection during either year of study (Table 7). Thus, additional species had little effect on the total number of resident individuals living in any of the study areas. Within the Ford residential subsection during 1972, the seven selected species accounted for 97 percent of the total avian population. It would be expected that where the bird species diversity is lower, the seven selected species would constitute a larger percentage of the total population. It is interesting to note, however, that even though bird species diversity in the Clark and Woodmere areas was lower than it was in the Golfview and Ford areas (see Table 2), the seven selected species constituted a greater percentage of the total bird population in the latter two areas. This resulted from the presence of a relatively large population of pigeons in the Clark and Woodmere areas; since pigeons were not one of the seven selected species, the proportion of the total population represented by these species would tend to be lower in these areas.

By examining the house sparrow data (Tables 5 and 8), one can see that although yearly differences are present, the sparrow population was generally significantly higher in the Clark and Woodmere residential areas than it was in the Golfview and Dearborn areas. The house sparrow population in the Ford residential subsection was grouped with the Golfview and Dearborn areas in 1972 and with the Clark and Woodmere areas in 1973. House sparrows constituted not less than 30 percent of the total bird population in any area during either year and accounted for 76 percent of the total bird population in the Clark residential subsection in 1972. Therefore, this species has by far the most significant impact on the total bird population. Woolfenden and Rohwer (1969) also found the house sparrow to be the most prevalent breeding bird in three suburban habitats in Florida.

The starling population was generally not significantly different between residential areas during either year of study (Table 9). Although this species was not nearly as abundant as the house sparrow, it did represent as much as 24 percent of the total population in the Woodmere subsection in 1972 and 12 to 19 percent of the total population in the Clark area both years. During the entire course of study, the starling had the least impact in the Dearborn area (Table 9).

The robin, like the starling, seemed to be evenly represented in each of the five residential subsections (Tables 5 and 10). There were only minor differences in the significance of robin populations in the five residential areas in 1972 and no significant difference in 1973. This species constituted between two and 14 percent of the total population in the areas that were studied (Table 10). It would appear from the data that this species is able to adapt, to some extent, to any urban residential situation.

The residential subsections seem to be divided into two groups when grackle population estimates are considered. In 1972 the estimates for the Clark and Woodmere areas were significantly lower than those for the Golfview and Ford areas; the grackle population of the Dearborn area was not significantly different from either of these two groups (Table 11). In 1973 the grackle population of the Clark and Woodmere areas was significantly lower than that of the Dearborn, Golfview, and Ford areas. The Ford residential subsection consistently had the highest grackle population, which may have resulted from the presence of nesting habitat in its wooded park subsection. Although the grackle constituted a small part of the bird population in the Clark and Woodmere residential subsections, it represented a fairly large segment of the total bird population in the other three areas (Table 11).

During both years of study, the blue jay populations of each residential area were essentially not significantly different from each other (Table 12). During both years, the Clark area had the lowest population estimate and the Ford area had the highest (Table 5). The blue jay was not a very abundant bird, since it represented only seven percent of the total population in the Ford subsection.

Cardinal populations were not significantly different between areas in 1973, and in 1972 only the population in the Golfview residential area was significantly different from that of any other area. There were no cardinals seen during either year in the Woodmere area and none seen in the Clark area in 1972. As can be seen from Tables 5 and 13, cardinals did not make up a large part of the total bird population in any of the areas.

During both years of study, the mourning dove population of the Clark and Woodmere areas was significantly lower than that of the Dearborn, Golfview, and Ford residential subsections. As is noted in Tables 5 and 14, this species was very scarce in the Clark and Woodmere areas. Estimates in the other three areas ranged from five to nine percent of the total population. Woolfenden and Rohwer (1969) noted this species as being the second most abundant breeding bird in their Florida study areas.

Park Subsections

Although the park subsections were ranked in a slightly different order in 1972 and 1973 with respect to total bird populations, significant differences between areas followed a similar pattern both years (Tables 6 and 7). The results show that the total bird populations of the Golfview, Woodmere, Ford, and Dearborn park areas were not significantly different from each other but were significantly different from the total bird population of the Clark park subsection. It is further shown in Table 7 that the population estimates in the Dearborn and Clark areas were not significantly different from each other but were significantly higher than the Ford, Golfview, and Woodmere areas. The seven selected species accounted for 43 to 83 percent of the total bird population. These percentages are generally lower than those for the residential subsections (Table 7), which tends to indicate that the parks as a group contained more diverse bird populations than did the residential areas. The Dearborn park subsection appeared to be the most diverse area, since the seven selected species made up only 43 percent of the total population in 1972 and 53 percent in 1973. These results coincide with those presented earlier (see Bird Species Diversity).

House sparrows were common only in the Clark park subsection during 1972 and in the Clark and Woodmere park areas during 1973 (Table 6). The lower sparrow population in the Woodmere area during 1972 may have been caused by a labor strike which resulted in the grass not being cut during the months of May and June. The longer grass made it difficult to see species such as the sparrow which extensively utilize the ground. The remaining study areas were not significantly different from each other during either 1972 or 1973. If one compares Tables 5 and 6, it becomes obvious that house sparrows are closely associated with the areas in which man lives.

During both 1972 and 1973, the Clark park subsection had a significantly higher starling population than did any of the remaining park areas (Table 9). It was also noted that during both years of study, the starling populations in the Golfview, Dearborn, Ford, and Woodmere park subsections were not significantly different from each other. Starlings did, however, constitute a fairly large segment of the total bird population of each park subsection; this is especially true in the Ford, Woodmere, and Clark areas. Starlings were abundant in the Ford park area in early spring, when they nested in cavities in many of the mature trees. The presence of this bird in the Clark and Woodmere areas tended to reflect feeding more than nesting activity.

Robin populations were generally not significantly different between park subsections (Table 10). In 1972 the robin population of the Clark area was significantly lower than only that of the Ford park subsection. In 1973 the populations of the Ford and Dearborn areas were significantly lower than only that of the Woodmere area. Robin populations were generally highest in those park settings that provided good nesting and feeding habitat (Tables 6 and 10); these are the same areas where the proportion of robins in the total population was highest (Table 10).

Grackle populations were not found to be significantly different in any of the park subsections which were studied (Table 11). As was the case with the starling populations, this bird represented a fair proportion of the total bird population in each area.

During 1972 the blue jay population in the Ford park area was significantly higher than that of the Golfview, Clark, and Woodmere park subsections. In 1973 the Ford area was significantly higher than only the Clark and Golfview subsections (Table 12). Populations were highest in the Ford subsection, where nesting habitat was superior to that of the other parks studied. In the Ford area blue jays constituted a significant proportion of the total population, while in the other areas they were not as important.

Cardinal populations seemed to fall into two groups which were significantly different from each other: the Clark, Woodmere, and Golfview areas and the Ford and Dearborn areas (Table 13). Within the Ford and Dearborn areas habitat conditions were excellent, and both the number of cardinals and their proportion of the total bird population were high (Tables 6 and 13).

Mourning dove populations within the five park subsections were not significantly different in 1972, and in 1973 only the Clark area was different from the Golfview, Dearborn, and Woodmere areas (Table 14). The dove population generally represented a relatively low portion of the total bird population within each park area. The actual number of mourning doves present in each of the park subsections was also low (Table 6).

Effect of Migrants on the Total Bird Population

Table 15 compares the mean resident bird population of each subsection to the mean migratory population seen during the spring-early summer period of 1972 and 1973 (including late winter species). The proportion of the total population represented by migrants is also given.

Within the residential subsections it is clear that migrants accounted for an insignificant portion of the total bird population that was present during the three months this survey was conducted. It should be noted that even when the daily records for the height of the migratory period are examined, migrants still constitute only a very small percentage of the birds which were observed. The Dearborn residential subsection was the only residential area where migrants made up more than one percent of the total population.

Within the park subsections of each study area, migrants were present in larger numbers than were found in the residential subsections. The Ford and Dearborn areas had the highest proportion of migrants, with proportions in the Clark, Woodmere, and Golfview areas being considerably lower.

The data in Table 15 tend to suggest that migratory birds represent a higher proportion of the total population in those areas where human interference is minimal. Little or no human traffic was encountered in the Ford and Dearborn park subsections, and in the Dearborn residential subsection the human population density was the lowest of any of the five residential areas studied.

While one might expect the actual population densities of migrants to be higher in areas of increased vegetative complexity, this was not the case in the residential subsections. The Golfview area was vegetatively more complex than the Dearborn area, but it had fewer migrants.

The higher migratory population of the Dearborn area could, of course, be due to the fact that this area was surrounded by a shrubby woodland. Within the park subsections, the more vegetatively complex areas (Ford and Dearborn) did have higher migrant populations.

INTERRELATIONSHIPS BETWEEN HABITAT AND BIRDLIFE

Introduction

During the present study, several habitat variables were measured in both the residential and park subsections of each study area. The information from each of the residential subsections was gathered in a similar manner (see Methods) and was treated by the statistical procedure described below. Although the same variables were measured (where appropriate) in the park subsections, this information was not always gathered in a similar manner in each park. Further, the Golfview and Dearborn park subsections were not homogeneous, thereby making it impossible to treat the information gathered in a statistically significant way. Those habitat variables measured but not discussed below are presented in Appendix A.

Habitat Analysis of Residential Subsections

Within each residential subsection, 33 variables were chosen for study (Table 16). The first 15 of these variables are related to the volume (structure) of the vegetation in each area. MacArthur and MacArthur (1961) have shown that bird species diversity is related to the structure of vegetation, namely to the foliage height diversity. MacArthur (1958) has also shown that the feeding habitat of certain warblers is related to the structure of the vegetation in which they are found. Thus, it was felt that the volume (structure) of the

Table 16. Habitat variables measured during the present study.

Variable Number	Variable Description
1	Volume of all vegetation per acre
2	Volume of all deciduous vegetation per acre
3	Volume of all coniferous vegetation per acre
4	Volume of all vegetation 0-3' per acre
5	Volume of all vegetation 4-12' per acre
6	Volume of all vegetation 13-30' per acre
7	Volume of all vegetation greater than 30' per acre
8	Volume of all deciduous vegetation 0-3' per acre
9	Volume of all deciduous vegetation 4-12' per acre
10	Volume of all deciduous vegetation 13-30' per acre
11	Volume of all deciduous vegetation greater than 30' per acre
12	Volume of all coniferous vegetation 0-3' per acre
13	Volume of all coniferous vegetation 4-12' per acre
14	Volume of all coniferous vegetation 13-30' per acre
15	Volume of all coniferous vegetation greater than 30' per acre
16	Average shrub leaf density
17	Average tree leaf density
18	Area of lawn per acre
19	Area of herbaceous growth per acre
20	Area of bare ground per acre
21	Area of buildings per acre
22	Area of concrete per acre
23	Area of gardens per acre
24	Volume of buildings per acre
25	Number of cats per acre
26	Number of dogs per acre
27	Number of adults (16 yrs. and older) per acre
28	Number of children (15 yrs. and younger) per acre
29	Number of nest boxes per acre
30	Number of houses per acre
31	Percent of houses with no eaves
32	Percent of houses with boxed eaves
33	Percent of houses with open eaves

vegetation in the study areas was a potentially important factor in explaining both bird species diversity and the population density of the seven selected species. Thomas and DeGraaf (1971) have also placed a major emphasis upon the volume of vegetation in their study of the relationship between habitat components and bird densities in the northeastern United States.

Vegetative volume was grouped by total volume, deciduous volume, and coniferous volume. Each of these categories was further subdivided into four height strata: 0 to 3 feet, 4 to 12 feet, 13 to 30 feet, and greater than 30 feet. These strata were chosen on the basis of the apparent layering of the vegetation in the study plots. Between 0 and 3 feet one may expect to find most of the smaller house shrubs (e.g., yew, barberry, juniper). The 4 to 12-foot layer includes small trees and the taller shrubs usually found along yard borders. Most of the volume of many yard trees (e.g., Norway maple, cherry) is found at the 13 to 30-foot level. The volume of vegetation above 30 feet consists primarily of old yard plantings and any original vegetation which may still be present. These strata coincide with the strata in which several of the seven selected species are usually found (e.g., cardinals are usually observed between four and 30 feet). Further, these strata are also pertinent to the location of man-made structures in the city (e.g., gutters between 13 and 30 feet, fences at or about three feet, and wires at or about 30 feet). These levels are also favorably related to the stratification of vegetation found in the park subsections. Variables 16 and 17 (average shrub and tree leaf densities) were measured in order to add a second structural component of the vegetation to the analysis.

Variables 18 through 30 are concerned with the areas of lawn, herbaceous growth, bare ground, concrete, and gardens, with the volume of buildings, and with the numbers of cats, dogs, adults, children, nest boxes, and houses. It was felt that these factors which are associated with the human population may also relate either directly or indirectly to the bird species diversity and/or to the density of the seven selected species. For example, the area of bare ground may relate directly to the availability of dusting areas for house sparrows, and herbaceous growth may act indirectly to increase bird species diversity by increasing the invertebrate food supply. It was anticipated that the volume and/or the number of houses in each study area might act as a single variable capable of tying together some or all of the human population density factors.

Variables 30 through 33 (no eaves, boxed eaves, open eaves) attempt to classify one structural component of the houses in each study area. Table 17 gives the values for the 33 independent variables in each residential subsection.

Initially, an attempt was made to determine if a relationship exists between the bird species diversity index and the population density estimates of each of the seven selected species (dependent variables) by using the least squares stepwise regression procedure (Draper and Smith, 1966; see Methods). A canned program available on the Control Data Corporation 6500 computer operated by Michigan State University was utilized; this procedure seeks to determine which independent variable(s) best explains the observed variation in the dependent variables. However, this method failed to give useful results because of the high degree of correlation existing between many of the

Table 17. Habitat measurement estimates for the residential subsections.

Variable Number	Unit of Measurement	Study Area				
		Clark	Woodmere	Ford	Golfview	Dearborn
1	cubic feet/acre	175,630	249,097	382,992	208,401	134,936
2	cubic feet/acre	174,075	248,653	379,624	186,219	124,934
3	cubic feet/acre	1,555	444	3,368	22,182	10,002
4	cubic feet/acre	2,409	2,340	5,526	11,922	9,320
5	cubic feet/acre	13,280	7,200	27,753	35,761	31,850
6	cubic feet/acre	76,398	86,478	194,493	110,518	64,246
7	cubic feet/acre	83,543	153,079	155,220	50,200	29,520
8	cubic feet/acre	1,954	2,018	3,632	7,083	3,129
9	cubic feet/acre	12,317	7,078	26,393	27,108	28,179
10	cubic feet/acre	76,262	86,478	194,379	103,150	64,106
11	cubic feet/acre	83,543	153,079	155,220	48,878	29,520
12	cubic feet/acre	455	322	1,894	4,839	6,191
13	cubic feet/acre	963	122	1,360	8,653	3,671
14	cubic feet/acre	135	0	144	7,368	140
15	cubic feet/acre	0	0	0	1,322	0
16	none	1.55	1.98	1.44	1.52	1.30
17	none	1.90	2.06	1.79	1.70	1.51
18	square feet/acre	15,163	10,568	22,433	18,613	20,839
19	square feet/acre	177	836	17	1,224	754

Table 17 (cont'd).

Variable Number	Unit of Measurement	Study Area				
		Clark	Woodmere	Ford	Golfview	Dearborn
20	square feet/acre	257	479	0	0	1,072
21	square feet/acre	11,435	13,234	8,098	6,717	5,702
22	square feet/acre	12,506	16,200	9,156	15,451	11,657
23	square feet/acre	632	836	1,359	828	340
24	cubic feet/acre	208,389	218,360	114,676	114,363	85,126
25	number/acre	1.060	.977	.497	.644	.138
26	number/acre	2.470	7.330	1.990	1.290	.828
27	number/acre	14.83	28.83	15.92	9.00	4.28
28	number/acre	8.83	11.73	5.97	3.43	2.48
29	number/acre	0	.977	.249	3.000	.966
30	number/acre	6.72	9.77	7.42	3.00	1.78
31	percent	73.92	22.22	100.00	21.05	20.00
32	percent	13.04	29.63	0	78.95	60.00
33	percent	13.04	48.15	0	0	20.00

independent variables. Although attempts were made to eliminate highly correlated values (95 percent or greater), the regression analysis still failed to yield useful information because the variables picked by the computer program were not meaningful, and the R^2 values (coefficients of determination) were fairly low.

In order to eliminate the problem of having a large number of highly correlated independent variables, and in an attempt to explain more of the variation in the dependent variables (higher R^2), a principal component factor analysis was carried out. This procedure was also available through a canned program at the Michigan State University Computer Center. The factor analysis program is capable of taking a large number of variables and organizing them into a few groups of highly correlated variables; these resultant groups are not significantly correlated to each other. The number of groups cannot exceed the number of replications of the data which is available. Thus, since five replications were used in the present study (the data for each study area representing one replicate), no more than five groupings of variables could be produced by the procedure. This method also made it possible to eliminate insignificant and highly correlated variables; therefore, the regression analysis could be run with both the groups of variables generated by the factor analysis and with the individual variables retained in the analysis. It was hoped that the first of these two processes would produce higher R^2 values and that the second would make it possible to identify the individual independent variables which were primarily responsible for the variation in the dependent variables.

On the first run of the principal component factor analysis, all of the 33 habitat variables discussed above were included, and three groups were created; the results of the analysis are shown in Table 18. Variables 9, 18, 5, 12, 4, and 20 were reflected (inversely related to all other variables). Enclosed within each red box in Table 18 are the correlations between individual independent variables; the green box to the right and at the bottom of the table contains the correlations that each individual variable has with each of the three groups. Within the blue box on the lower right are the correlations that the groups have with each other. Those numbers falling on a diagonal (upper left to lower right) are the values for communality, or the proportion of common variation that a variable has with the group in which it is located.

After examining Table 18, and taking other factors into account, 13 of the original 33 independent variables were eliminated. Variables 16 and 17 (average shrub and tree leaf density) were excluded on the basis that they were not highly meaningful in terms of interpreting the variation in the dependent variables. These variables were also rather highly correlated with other variables left in the analysis (Table 18).

Variables 31, 32, and 33 (no eaves, boxed eaves, and open eaves) were eliminated because they were each in a different group, and, as can be seen from the green boxes (Table 18), they were not highly correlated with the groups in which they were located. Further, on the basis of field observation, these variables did not seem to be related to any of the eight dependent variables which were measured. It should be noted, however, that they may be related to pigeon numbers. Variable 22 (area of concrete) was excluded since it was almost equally correlated to each of the three groups (Table 18, green box). Finally, variables 21, 9, 15, 13, 1, 6, and 7 (area of buildings; volume of

Table 18. Results of the first principal component factor analysis.

Variable Number	24*	21	17	9	16	18	28	25	5	26	27	12	30	4	33	22	15	14	29	8	13	3	19	32	1	23	2	10	6	7	11	20	32	Gp. 1	Gp. 2	Gp. 3
24	92**	98	92	98	82	90	95	94	95	79	80	88	79	84	60	47	-31	-32	-36	-59	-60	-63	-19	-45	-1	2	4	-27	-29	50	50	17	8	96	-47	9
21	98	99	96	98	86	87	99	88	97	87	90	92	89	89	66	40	-41	-42	-42	-64	-70	-72	-24	-54	14	15	20	-14	-16	65	65	17	13	100	-55	23
17	92	96	93	90	89	80	97	89	88	86	95	94	94	81	53	41	-25	-26	-29	-45	-59	-61	-21	-55	35	38	40	8	6	77	77	40	20	96	-44	44
9	98	98	90	96	85	94	96	86	98	86	83	83	78	85	74	49	-39	-40	-37	-66	-65	-67	-13	-41	-6	-6	0	-34	-36	50	50	1	-3	98	-50	2
16	82	86	89	85	85	91	87	75	79	96	92	69	78	59	75	70	-8	-10	2	-31	-40	-40	21	-18	16	18	19	-14	-15	61	61	17	-24	92	-17	18
18	90	87	80	94	91	82	84	80	85	86	76	63	61	61	80	76	-13	-14	-4	-43	-38	-39	22	-8	-23	-20	-18	-50	-51	32	32	-5	-36	91	-19	-18
28	95	99	97	96	87	84	99	84	97	90	94	93	93	90	67	35	-45	-46	-45	-65	-74	-75	-27	-59	23	22	30	-5	-8	73	73	17	16	99	-59	31
25	94	88	89	86	75	80	84	71	79	64	71	85	71	68	33	49	-3	-4	-17	-31	-37	-41	-15	-38	7	17	10	-14	-14	45	45	47	16	84	-25	20
5	95	97	88	98	79	85	97	79	92	84	84	87	83	93	74	31	-57	-58	-55	-79	-80	-81	-30	-57	3	-0	11	-24	-27	58	59	-4	10	96	-67	11
26	79	87	86	86	96	86	90	64	84	85	95	70	83	68	85	55	-32	-33	-17	-50	-58	-57	8	-30	20	16	25	-12	-14	68	68	-0	-18	92	-36	20
27	80	90	95	83	92	76	94	71	84	95	87	85	95	77	66	38	-34	-35	-28	-48	-64	-65	-14	-52	44	42	49	15	12	85	85	25	11	93	-46	47
12	88	92	94	83	69	63	93	85	87	70	85	75	94	92	37	9	-44	-45	-56	-60	-74	-77	-53	-78	42	43	48	20	17	79	79	41	49	87	-66	54
30	79	89	94	78	78	61	93	71	83	83	95	94	75	87	49	12	-47	-48	-50	-57	-76	-77	-42	-75	57	54	63	31	28	93	93	35	40	87	-64	63
4	84	89	81	85	59	61	90	68	93	68	77	92	87	67	54	-4	-74	-75	-78	-87	-93	-94	-62	-82	24	18	32	2	-3	69	70	4	43	82	-87	33
33	60	66	53	74	75	80	67	33	74	85	66	37	49	54	48	53	-46	-47	-19	-63	-54	-52	22	-6	-23	-32	-17	-50	-53	30	31	-52	-48	69	-36	-28
22	47	40	41	49	70	76	35	49	31	55	38	9	12	-4	53	20	48	47	61	20	28	28	78	54	-39	-30	-40	-57	-54	-9	-10	0	-76	44	49	-40
15	-31	-41	-25	-39	-8	-13	-45	-3	-57	-32	-34	-44	-47	-74	-46	48	90	100	93	94	92	91	70	73	-13	4	-21	-2	4	-43	-43	45	-40	-35	95	-14
14	-32	-42	-26	-40	-10	-14	-46	-4	-58	-33	-35	-45	-48	-75	-47	47	100	91	93	94	93	92	69	73	-13	4	-21	-2	4	-44	-44	45	-39	-36	95	-14
29	-36	-42	-29	-37	2	-4	-45	-17	-55	-17	-28	-56	-50	-78	-19	61	93	93	97	88	90	91	90	88	-23	-10	-30	-16	-11	-45	-46	18	-67	-32	99	-29
8	-59	-64	-45	-66	-31	-43	-65	-31	-79	-50	-48	-60	-57	-87	-63	20	94	94	88	83	94	94	59	67	4	18	-4	21	27	-40	-41	43	-26	-59	91	0
13	-60	-70	-59	-65	-40	-38	-74	-37	-80	-58	-64	-74	-76	-93	-54	28	29	93	90	94	94	100	70	85	-29	-16	-37	-10	-4	-68	-68	18	-46	-65	97	-33

Table 18 (cont'd).

Variable Number	24	21	17	9	16	18	28	25	5	26	27	12	30	4	33	22	15	14	29	8	13	3	19	32	1	23	2	10	6	7	11	20	32	Gp. 1	Gp. 2	Gp. 3
3	-63	-72	-61	-67	-40	-39	-75	-41	-81	-57	-65	-77	-77	-94	-52	28	91	92	91	94	100	95	72	87	-29	-17	-37	-11	-5	-68	-68	14	-49	-66	97	-35
19	-19	-24	-21	-13	21	22	-27	-15	-30	8	-14	-53	-42	-62	22	78	70	69	90	59	70	72	62	91	-45	-38	-50	-47	-43	-46	-46	-19	-92	-12	79	-55
32	-45	-54	-55	-41	-18	-8	-59	-38	-57	-30	-52	-78	-75	-82	-6	54	73	73	88	67	85	87	91	75	-61	-54	-67	-51	-47	-76	-76	-28	-85	-46	86	-70
1	-1	14	35	-6	16	-23	23	7	3	20	44	42	57	24	-23	-39	-13	-13	-23	4	-29	-29	-45	-61	100	98	100	95	94	82	82	63	66	14	-28	100
23	2	15	38	-6	18	-20	22	17	-0	16	42	43	54	18	-32	-30	4	4	-10	18	-16	-17	-38	-54	98	100	96	94	94	77	77	78	65	14	-15	100
2	4	20	40	0	19	-18	30	10	11	25	49	48	63	32	-17	-40	-21	-21	-30	-4	-37	-37	-50	-67	100	96	100	93	92	86	86	60	68	20	-36	100
10	-27	-14	8	-34	-14	-50	-5	-14	-24	-12	15	20	31	2	-50	-57	-2	-2	-16	21	-10	-11	-47	-51	95	94	93	87	100	61	61	65	72	-16	-16	93
6	-29	-16	6	-36	-15	-51	-8	-14	-27	-14	12	17	28	-3	-53	-54	4	4	11	27	-4	-5	-43	-47	94	94	92	100	85	59	58	67	69	-18	-10	92
7	50	65	77	50	61	32	73	45	58	68	85	79	93	69	30	-9	-43	-44	-45	-40	-68	-68	-46	-76	82	77	86	61	59	64	100	43	51	66	-58	80
11	50	65	77	50	61	32	73	45	59	68	85	79	93	70	31	-10	-43	-44	-46	-41	-68	-68	-46	-76	82	77	86	61	58	100	63	42	51	66	-59	80
20	17	17	40	1	17	-5	17	47	-4	-0	25	41	35	4	-52	0	45	45	18	43	18	14	-19	-28	63	78	60	65	67	43	42	44	52	14	19	66
31	8	13	20	-3	-24	-36	16	16	10	-18	11	49	40	43	-48	-76	-40	-39	-67	-26	-46	-49	-92	-85	66	65	68	72	69	57	51	52	48	2	-60	69
Gp. 1	96	100	96	98	92	91	99	84	96	92	93	87	87	82	69	44	-35	-36	-32	-59	-65	-66	-12	-46	14	14	20	-16	-18	66	66	14	2	100	-47	21
Gp. 2	-47	-55	-44	-50	-17	-19	-59	-25	-67	-36	-46	-66	-64	-87	-36	49	95	95	99	91	97	97	79	86	-28	-15	-36	-16	-10	-58	-59	19	-60	-47	100	-34
Gp. 3	9	23	44	2	18	-18	31	20	11	20	47	54	63	33	-28	-40	-14	-14	-29	0	-33	-35	-55	-70	100	100	100	93	92	80	80	66	69	21	-34	100

* See Table 15 for an explanation of habitat variable numbers.

** Values for communality.

*** Red box represents correlations between variables within each group; green box represents the correlation that each variable has with the group; blue box represents the correlations of the groups with each other.

deciduous growth 4 to 12 feet; volume of coniferous growth greater than 30 feet; volume of all vegetation; volume of all vegetation 13 to 30 feet; and volume of all vegetation greater than 30 feet, respectively) were eliminated because they were 98 percent or more correlated to another independent variable, thereby measuring the same thing that it was measuring.

The results of the factor analysis indicate that the 33 independent variables which were first analyzed may be reduced to 20. The principal component factor analysis was then run a second time using the 20 variables in order to determine if any of the interrelationships between variables had changed (Table 19). These results indicated that the relationships were not altered and that the variables again fell into three distinct groups. Within the first group are variables 24, 18, 28, 25, 5, 26, 27, 12, 30, and 4 (see Table 16 for explanation of variable numbers). It is obvious that this group of factors represents the various human-density-related variables. Variables 4 and 5 (volume of all vegetation 0 to 3 feet and 4 to 12 feet) are in this group but are reflected, thus indicating that the higher the human density factors, the lower the total volume of vegetation between 0 and 12 feet.

Variables 14, 29, 8, 3, and 19 fall within the second group (Table 16), which generally represents coniferous volume. The underlying factor which links coniferous volume to other variables in this group is affluence. Since all coniferous vegetation was planted and not present originally, and since its presence requires money and at least some interest on the part of the homeowner, then where there is more coniferous volume one might also expect more house shrubs (deciduous volume 0 to 3 feet) and nest boxes. The area of herbaceous growth was also placed in this group; it increased as coniferous volume increased.

Table 19. Results of the second principal component factor analysis.

Variable Number	24*	18	28	25	5	26	27	12	30	4	14	29	8	3	19	23	2	10	11	20	Gp. 1	Gp. 2	Gp. 3
24	92**	90	95	94	95	79	80	88	79	84	-32	-36	-59	-63	-19	2	4	-27	50	17	96	-45	11
18	90	69	84	80	85	86	76	63	61	61	-14	-4	-43	-39	22	-20	-18	-50	32	-5	83	-17	-14
28	95	84	102	84	97	90	94	93	93	90	-46	-45	-65	-75	-27	22	30	-5	83	17	101	-56	31
25	94	80	84	71	79	64	71	85	71	68	-4	-17	-31	-41	-15	17	10	-14	45	47	84	-23	24
5	95	85	97	79	93	84	84	87	83	93	-58	-55	-79	-81	-30	-0	11	-24	59	-4	97	-66	10
26	79	86	90	64	84	76	95	70	83	68	-33	-17	-50	-57	8	16	25	-12	68	-0	87	-33	22
27	80	76	94	71	84	95	86	85	95	77	-35	-28	-48	-65	-14	42	49	15	85	25	93	-42	50
12	88	63	93	85	87	70	85	86	94	92	-45	-56	-60	-77	-53	43	48	20	79	41	93	-64	53
30	79	61	93	71	83	83	95	94	83	87	-48	-50	-57	-77	-42	54	63	31	93	35	91	-60	64
4	84	61	90	68	93	68	77	92	87	77	-75	-78	-87	-94	-62	18	32	2	70	4	87	-86	29
14	-32	-14	-46	-4	-58	-33	-35	-45	-48	-75	91	93	94	92	69	4	-21	-2	-44	45	-43	96	-4
29	-36	-4	-45	-17	-55	-17	-28	-56	-50	-78	93	101	88	91	90	-10	-30	-16	-46	18	-42	101	-19
8	-59	-43	-65	-31	-79	-50	-48	-60	-57	-87	94	88	83	94	59	18	-4	21	-41	43	-63	91	8
3	-63	-39	-75	-41	-81	-57	-65	-77	-77	-94	92	91	94	92	72	-17	-37	-11	-68	14	-73	96	-27
19	-19	22	-27	-15	-20	8	-14	-53	-42	-62	69	90	59	72	57	-38	-50	-47	-46	-19	-25	75	-46
23	2	-20	22	17	-0	16	42	43	54	18	4	-10	18	-17	-38	108	96	94	77	78	21	-10	104
2	4	-18	30	10	11	25	49	48	63	32	-21	-30	-4	-37	-50	96	99	93	86	60	28	-31	100
10	-27	-50	-5	-14	-24	-12	15	20	31	2	-2	-16	21	-11	-47	94	93	83	61	65	-7	-12	91
11	50	32	73	45	59	68	85	79	93	70	-44	-46	-41	-68	-46	77	86	61	54	42	72	-54	74
20	17	-5	17	47	-4	-0	25	41	35	4	45	18	43	14	19	78	60	65	42	45	20	22	67

Table 19 (cont'd).

Variable Number	24	18	28	25	5	26	27	12	30	4	14	29	8	3	19	23	2	10	11	20	Gp. 1	Gp. 2	Gp. 3
Gp. 1	96	83	101	84	97	87	93	93	91	87	-43	-42	-63	-73	-25	21	28	-7	72	20	100	-54	31
Gp. 2	-45	-17	-56	-23	-66	-33	-42	-64	-60	-86	96	101	91	96	75	-10	-31	-12	-54	22	-54	100	-19
Gp. 3	11	-14	31	24	10	22	50	53	64	29	-4	-19	8	-27	-46	104	100	91	74	67	31	-19	100

* See Table 15 for explanation of variable numbers.

** Values for communality are on the diagonal (upper left to lower right).

*** Red box represents correlations between variables within each group; green box represents the correlation that each variable has with the group; blue box represents the correlations of the groups with each other.

Group three included variables 23, 2, 10, 11 and 20 (Table 16). This group is strongly related to the volume of deciduous growth, particularly to that found in the higher strata. Although variables 23 and 20 are not related to deciduous volume, the factor analysis revealed that they increase with an increase in deciduous volume. Table 19 (blue box) shows variable 23 to be highly related to the group, while variable 20 is not.

Analysis of the Relationship between Residential Habitat and Birdlife

At this point in the analysis, both the 20 individual independent variables and the three groups which they formed were regressed against each of the eight dependent variables. In the first case (20 individual independent variables versus dependent variables), although a lower value for R^2 might be obtained, it was hoped that the particular variables which were largely responsible for the variation in the dependent variables would be identified; it was anticipated that in the second case (groups versus dependent variables) higher R^2 values would be achieved. The analysis was run separately for 1972 and 1973.

The results of running the regression analysis in this manner indicated that generally when the variable groups, rather than individual variables, were regressed against the dependent variables, lower R^2 values were obtained. There were four cases in 1973 where R^2 values were slightly higher for the groups than for the individual variables (starling, robin, blue jay, and cardinal), but the greatest difference only accounted for 3.44 percent more variation in the dependent variables. Therefore, only the latter regression results (individual variables versus dependent variables) will be discussed below.

Tables 20 and 21 give the F statistic and its significance, as well as the value for R^2, for the overall regression for each of the dependent variables for 1972 and 1973, respectively. There were 66 degrees of freedom in 1972 and 59 in 1973. These tables also present data for the independent variables which are important in explaining the variation in the dependent variables. The regression coefficient is that value which is multiplied by the independent variable in the regression equation while the constant is the Y intercept. The regression coefficient can be positive or negative, depending upon its relationship to the dependent variables. The R^2 deletes values represent the amount of variation explained by the regression equation if a particular independent variable is deleted. Thus, in Table 20 in the case of bird species diversity, if one deletes the volume of all deciduous vegetation from the equation, 53.12 percent of the variation will still be explained by the remaining independent variables.

When one examines the values for R^2 for 1972 and 1973 (Tables 20 and 21), it is immediately apparent that this value is higher in every case except one (the grackle) for 1972. This variation in R^2 values is caused by the difference in the methods which were used to gather bird population data each year. During the first year of study when transects were used, there was less variation in the numbers of birds seen (especially the more uncommon ones) than there was during the second year. When time-area counts were utilized and the points of observation chosen at random, it was possible to observe many individual birds on a hit-or-miss basis. Thus, one might see five cardinals in the Ford area during one week and not see any the next week. During the first year of study, five birds would have been seen each week,

Table 20. Results of the least squares stepwise regression analysis for 1972.

Dependent Variable	For overall regression R^2	F Statistic	Significance	Independent Variable	Regression Coefficient	Significance	R^2 Deletes
Bird Species Diversity	.5938	30.7043	< .0005	Constant	1.68730154	< .0005	-.02355
				Vol. All Dec.	.00000136	.003	.53125
				Vol. Buildings	-.00000495	< .0005	.17953
				Area Herb. Growth	.00026665	.002	.52739
House Sparrow	.4835	19.6589	< .0005	Constant	2.14288357	.003	.40438
				Vol. All Dec.	-.00000505	.005	.41471
				Vol. Buildings	.00001514	< .0005	.17587
				Area Herb. Growth	-.00098798	.004	.41101
Starling	.3862	13.2109	< .0005	Constant	.05100965	.656	.38421
				Vol. Buildings	.00000332	< .0005	.12241
				Vol. Conif. 13-30	.00007523	< .0005	.17091
				Area Herb. Growth	-.00035492	.001	.25887
Robin	.4419	16.6256	< .0005	Constant	.27813207	.030	.39809
				Vol. All Dec.	.00000165	< .0005	.22308
				Vol. Conif. 13-30	.00002459	.020	.39158
				Vol. Buildings	-.00000207	< .0005	.31473
Grackle	.4026	21.5657	< .0005	Constant	.68396540	< .0005	.25063
				Vol. All Dec.	.00000208	< .0005	.24626
				Vol. Buildings	-.00000420	< .0005	.14722
Blue Jay	.4101	22.2423	< .0005	Constant	.04950748	.611	.40765
				Vol. All Dec.	.00000169	< .0005	.09825
				Vol. Buildings	-.00000156	.001	.30351
Cardinal	.5348	36.7889	< .0005	Constant	.11048655	< .0005	.41373
				Vol. Buildings	-.00000052	.002	.45616
				Vol. Conif. 13-30	.00001818	< .0005	.25024

Table 20 (cont'd).

Dependent Variable	For overall regression R^2	F Statistic	Significance	Independent Variable	Regression Coefficient	Significance	R^2 Deletes
Mourning Dove	.5212	34.8287	< .0005	Constant	.30673087	< .0005	.21441
				Vol. All Dec.	.00000048	.001	.43733
				Vol. Buildings	-.00000175	< .0005	.07508.

Table 21. Results of the least squares stepwise regression analysis for 1973.

Dependent Variable	For overall regression R^2	For overall regression F Statistic	For overall regression Significance	Independent Variable	Regression Coefficient	Significance	R^2 Deletes
Bird Species Diversity	.5633	74.8262	< .0005	Constant	2.09280294	< .0005	-5.04802
				Vol. Buildings	-.00000419	< .0005	.00000
House Sparrow	.4120	19.9714	< .0005	Constant	2.20320963	< .0005	.24629
				Vol. Buildings	.00001777	< .0005	.09850
				Area Bare Ground	-.00104643	.023	.35538
Starling	.1365	9.1649	.004	Constant	.13376455	.787	.13536
				Vol. Buildings	.00000945	.004	.00000
Robin	.1380	9.2873	.003	Constant	.31459548	.026	.06033
				Vol. Dec. 0-3	.00010433	.003	.00000
Grackle	.4100	19.8078	< .0005	Constant	2.02595576	< .0005	.19231
				Vol. All Dec.	.00000374	.005	.32120
				Vol. Buildings	.00001178	< .0005	.08782
Blue Jay	.3204	13.4361	< .0005	Constant	.46014796	.034	.26429
				Vol. All Dec.	.00000232	< .0005	.14990
				Vol. Buildings	-.00000361	.001	.16954
Cardinal	.1785	12.6040	.001	Constant	.43898386	< .0005	-.19316
				Vol. Buildings	-.00000192	.001	.00000
Mourning Dove	.3839	36.1383	< .0005	Constant	1.42022894	< .0005	-.39339
				Vol. Buildings	-.00000631	< .0005	.00000

since the entire study area was observed. Therefore, generally speaking, the 1972 data (Table 20) gives more meaningful results in terms of higher R^2 values than the 1973 data.

In the case of the bird species diversity index, there was less difference between 1972 and 1973 (see Bird Species Diversity) than was the case for individual bird population estimates (see Spring-Summer Bird Surveys); this is a function of the equation used to calculate bird species diversity. Because of this, the R^2 values for bird species diversity for 1972 and 1973 are closer to each other than are most of the values for the individual birds studied.

Bird Species Diversity Index

The results of the regression analysis show that in 197? 59.38 percent of the variation in bird species diversity was accounted for by the volume of all deciduous vegetation, the volume of buildings, and the area of herbaceous growth (Table 20). In 1973 the volume of buildings alone accounted for 56.33 percent of the variation in bird species diversity (Table 21). These figures are the highest R^2 values computed in the present study, and they present a reasonable explanation of the variation encountered. The most important independent variable is the volume of buildings; it was the only variable in the regression equation in 1973 and was the one which accounted for most of the variation in the dependent variables in 1972 (Table 20, R^2 deletes). The relationship between building volume and bird species diversity is an inverse one: the greater the volume, the lower the bird species diversity.

Although the volume of buildings acts primarily in an indirect manner in its effect on bird species diversity, it may also act directly by providing the necessary habitat components for a limited number of species. House sparrows and pigeons may be provided with more cracks and crevices for nesting and with more roosting sites where there is a greater volume of buildings than where volume is limited; the effect of this would be to increase the proportion of these species in the total population, thereby reducing the bird species diversity. The indirect effect of the volume of buildings on bird species diversity is to reduce the volume of space available for the occurrence of the proper habitat components or arrangement of components necessary to accommodate a large number of species. Thus, bird species diversity is lowered when there is a large volume of buildings, both by reducing the number of species that can occur and by increasing the number of individuals of a few species.

Although the volume of all deciduous vegetation and the area of herbaceous growth were not as important as the volume of buildings in accounting for the variation in bird species diversity, they did act in a significant and positive manner in 1972. An increase in the volume of all deciduous vegetation acts to increase bird species diversity by providing a wider variety of habitat. This is, to some extent, what one would expect, and it reflects the same basic kind of relationship that MacArthur and MacArthur (1961) described. The area of herbaceous growth may act to increase bird species diversity by meeting the habitat requirements and by providing food for species which would otherwise not be able to exist in an urban environment. Thus, both the volume of all deciduous vegetation and the area of herbaceous growth will increase the number of species present, which in turn acts to increase bird species diversity.

It should be pointed out that in 1972 and 1973 40.63 and 43.67 percent, respectively, of the variation in bird species diversity was unexplained. Future research should seek to determine which factors are responsible for this variation.

House Sparrow

The regression analysis revealed that 48.35 percent of the variation in house sparrow numbers in 1972 was accounted for by the volume of all deciduous vegetation, the volume of buildings, and the area of herbaceous growth (Table 20). In 1973 41.20 percent of the variation was explained by the volume of buildings and the area of bare ground (Table 21). Only the 1972 data will be discussed in detail because of those reasons cited previously.

As can be noted from Table 20, the volume of buildings is responsible for most of the variation in house sparrow numbers. This factor would be expected to act in the following manner: as the volume of buildings increases, there is a subsequent increase in the number of nest sites (e.g., eaves, cracks and crevices in buildings and roofs). Additional food (usually associated with garbage) might also be supplied by the increased number of people living in a residential area that has a higher volume of buildings.

The volume of all deciduous vegetation and the area of herbaceous growth were both negatively related to house sparrow numbers. Neither factor, however, accounted for a major portion of the explained variation, although both were significant in the contribution they made to the regression equation (Table 20). It is, of course, not always possible to state that a cause-and-effect relationship exists between independent and dependent variables in a regression equation. This is perhaps the case in the present example, since there appears to be no biological relationship between less deciduous volume and/or a smaller area of herbaceous growth and house sparrow numbers.

In 1973 the area of bare ground was significant in accounting for part of the variation in house sparrow numbers; however, the relationship was inverse, which is the opposite of what one might expect since this species uses bare ground for dusting (Woolfenden and Rohwer, 1969). This relationship appeared to be the result of the construction of a house in the Dearborn residential subsection; this area also had the second lowest house sparrow population (see Spring-Summer Bird Surveys).

Starling

The variables fitting the regression equation for the starling explained only 38.62 and 13.65 percent of the variation in starling numbers in 1972 and 1973, respectively. The 1973 results will not be discussed since the R^2 value is very low, and the only independent variable in the equation is also part of the 1972 regression equation. Since starlings are often associated with urban areas, it is not surprising that the volume of buildings is related in a positive manner to the starling population and that it accounts for the largest part of the explained variation. Starlings were noted to nest in and on buildings during this study; therefore, an increased volume of buildings would be expected to provide additional nesting and roosting sites for this species. The majority of starlings seen in all residential areas except the Dearborn area were observed in vegetative cover between 13 and 30 feet (see Appendix C, Tables 1-5); thus, it is not surprising that the volume of coniferous vegetation between 13 and 30 feet is positively related to starling numbers. The area of herbaceous growth is related to the starling population in a negative manner. As was the case with the house sparrow, a cause-and-effect relationship need not actually apply for an independent variable to be placed in a regression equation; this also seems to be the case with the starling. During both years of study, the unexplained variation in the case of the starling is greater than that for any other species (61.38 and 86.35 percent for 1972 and 1973, respectively). It is, therefore, obvious that other factors more important than those chosen for this study must be responsible for the variation in starling numbers in Detroit residential areas.

Robin

As was the case with the starling, considerably more variation in numbers of robins was explained in 1972 than in 1973 (44.18 and 13.80 percent, respectively); therefore, only the 1972 data will be discussed in detail. The individual variable most significantly related to robin numbers was the volume of all deciduous vegetation (Table 20, R^2 deletes). Within urban areas, increased volumes of deciduous vegetation will generally be the result of adding volume to trees rather than to shrubs; thus, a residential area of relatively high deciduous volume will probably have the appearance of an open park (a lot of lawn area with most of the deciduous volume in the overstory). This type of situation would supply more possible nest sites (with one exception, all robin nests were found in the middle and lower strata of deciduous trees, see Appendix D) and feeding areas. In fact, the two areas with the most open-park appearance (Ford and Golfview) had the highest robin populations. The volume of houses was negatively related to robin populations in a significant manner; this factor may affect robin numbers by providing more space for trees and lawn.

The volume of coniferous vegetation between 13 and 30 feet was also significantly related to robin numbers. While only one robin nest was located in coniferous vegetation, this was the height stratum in which nearly all robin nests were located (see Appendix D). It should be noted that 55.81 percent of the variation in robin numbers was still unexplained after the regression analysis had been completed; therefore, other factors may be more important than those discussed above in affecting robin population estimates.

Grackle

Approximately 40 percent of the variation in grackle numbers was accounted for in both 1972 and 1973 by the volume of all deciduous vegetation and the volume of buildings (Tables 20 and 21). Both independent variables have positive values in the regression equation. For each year, the volume of all deciduous vegetation was the most important habitat variable measured. Grackle abundance in the residential study areas was perhaps less dependent upon the presence of nesting birds than was the abundance level of any other of the seven selected species. Only one nest was discovered in a residential area, while many were found in the park subsections, especially those of the Ford and Golfview areas (see Appendix D). The occurrence of birds in the residential areas was more directly related to the presence of roosting birds. It is apparent that an increase in total deciduous volume also means an increase in possible roosting sites for grackles.

The volume of buildings was negatively related to grackle numbers. Where there was more volume of buildings, there was less total deciduous volume, which means less space for roosting. Since about 60 percent of the variation in grackle population levels is unexplained, and since grackle numbers were highest near the park areas in which they nested, there is obviously more involved than just the volume of all deciduous vegetation and the volume of buildings.

Blue Jay

In 1972 and 1973 40.26 and 32.04 percent, respectively, of the variation in blue jay numbers was accounted for by the volume of all deciduous vegetation and the volume of buildings (Tables 20 and 21). Kendeigh (1944) has suggested that the blue jay is a species of the forest edge, and Woolfenden and Rohwer (1969) have noted that suburban areas with trees resemble forest edges. It is not surprising, therefore, to find that the volume of all deciduous vegetation is positively related to blue jay numbers; it was also determined that the volume of buildings was negatively related. It follows logically, then, that areas which closely resemble forest edges (areas with relatively few houses and more deciduous volume) have the highest blue jay populations. The unexplained variation in blue jay numbers is, however, relatively large (58.99 percent in 1972 and 67.96 percent in 1973), and other unanalyzed factors obviously must play a role in determining them. Woolfenden and Rohwer (1969) have noted that ". . . an additional unanalyzed factor was the difference in the type of trees that dominated the pine and oak [residential] plots and the food these might supply." Possibly the tree species occurring in the five Detroit study areas contributed at least in part to the unexplained variation in blue jay population levels.

Cardinal

Cardinal population estimates constituted one of the three dependent variables which had over 50 percent (53.48) of their variance accounted for in 1972 by the independent variables which were measured. Because of the inherent problems in the time-area method which were discussed earlier, the 1973 value for R^2 was only 17.85 percent; therefore, only the 1972 data is discussed below.

The volume of buildings and the volume of coniferous vegetation between 13 and 30 feet were the independent variables chosen by the regression program (Table 20). The volume of coniferous vegetation between 13 and 30 feet was positively related to cardinal numbers and was the most important variable identified by the analysis. Although coniferous cover is ideally suited for cardinal nesting, the height stratum involved is at the upper end of the nest-height range reported by Woolfenden and Rohwer (1969). The present study, however, did not measure nesting height, but rather the height where birds were most frequently seen. Cauley (1974) has noted that cardinals display at higher elevations than they choose for nesting, and Woolfenden and Rohwer (1969) have noted that cardinals feed fledglings at elevations above their nests. The 13 to 30-foot stratum of coniferous volume which was shown to be positively related to cardinal numbers in this study may actually be more closely related to these two observations and to the fact that ground disturbance may force birds into this stratum than it is to nesting.

The volume of buildings was inversely related to cardinal numbers, as might be expected. This habitat variable probably acts indirectly in its effect on the cardinal population. For example, where a lower volume of buildings occurs, there is a larger volume of low yard and house shrubs which may be used for nesting; there is also less human disturbance. The unexplained variation in cardinal numbers was 46.52 percent in 1972.

Mourning Dove

The mourning dove was the third species in 1972 which had over 50 percent (52.12) of the variance in its numbers explained by the habitat variables measured during this study. In 1973 38.39 percent of the variance was accounted for by the volume of buildings; therefore, only the 1972 data will be discussed below.

The volume of all deciduous vegetation was related in a positive manner to mourning dove numbers, while the volume of buildings was negatively related. The latter factor was responsible for most of the variation in the population levels of this species (Table 20, R^2 deletes). Swank (1955) has indicated that open areas are important to mourning doves because they are the source of nesting material; thus, where the volume of buildings is less, one may expect more of the open areas needed for gathering nest material. Doves must, of course, also have trees in which to nest, so the greater the volume of all deciduous vegetation in an area, the greater the number of possible nesting sites. Again, as is the case with all dependent variables studied, a fairly large (47.88) percentage of the variation in mourning dove numbers is unaccounted for, and it is possible that some additional factors which were not measured are responsible for an important part of the unexplained variance.

Analysis of the Relationship between Park Habitat and Birdlife

As was noted in the previous section, it was impossible to use a statistical approach in determining the relationship of bird species diversity and the population densities of seven selected species to the habitat variables measured. This section will attempt to discuss the relationships existing between these factors in each of the five park subsections. The values for the independent variables for the park areas are presented in Table 22; those variables not applicable are left blank.

Clark Subsection

During both years of study, Clark Park had the highest bird population of any of the five park areas. This subsection acted primarily as a feeding area for birds. Species which nested in the surrounding residential subsection (i.e., starling, house sparrow, pigeon) were often seen throughout the park on the ground or at a special feeding station during the early morning bird surveys. The most abundant bird found in the park was the starling (Table 6). This bird not only fed within the area, but it also nested in cavities in some of the older trees. The robin was the only other member of the seven selected species which was known to nest in this park, and its population level was not high. There was very little volume of vegetation between the ground and ten to 12 feet (Table 22); thus, the cardinal was a rare species in the Clark Park study area.

The human factor seemed to be the most important element affecting the bird population within Clark Park. This factor was responsible for the presence of both a large number of a few species and a few individuals of a large number of species; in short, it caused this area

Table 22. Habitat measurement estimates for the park subsections.

Variable Number	Unit of Measurement	Study Area				
		Clark	Woodmere	Ford	Golfview	Dearborn
1*	cu ft/acre	507,309	397,526	2,448,752	250,032	545,690
2	cu ft/acre	507,309	397,466	2,448,752	249,910	545,690
3	cu ft/acre	0	60	0	121	0
4	cu ft/acre	183	171	54,895	2,957	3,780
5	cu ft/acre	5,656	5,089	174,024	4,989	67,742
6	cu ft/acre	206,523	179,777	262,982	18,024	186,768
7	cu ft/acre	294,947	212,489	1,956,851	224,062	287,400
8	cu ft/acre	183	145	54,895	2,908	3,780
9	cu ft/acre	5,656	5,055	174,024	4,913	67,742
10	cu ft/acre	206,523	179,777	262,982	18,024	186,768
11	cu ft/acre	294,947	212,489	1,956,851	224,062	287,400
12	cu ft/acre	0	26	0	49	0
13	cu ft/acre	0	34	0	76	0
14	cu ft/acre	0	0	0	0	0
15	cu ft/acre	0	0	0	0	0
16	none	1.25	1.15	2.42	1.34	1.64
17	none	2.11	2.05	2.25	2.02	1.84
18	sq ft/acre	41,116	32,235		40,119	
19	sq ft/acre	0	98	15,063	825	21,344
20	sq ft/acre	0	0	24,685	1,320	19,602
21	sq ft/acre	222				
22	sq ft/acre	2,222	4,112		436	
23	sq ft/acre	**				
24	cu ft/acre	2,854				
25	number/acre					
26	number/acre					
27	number/acre					
28	number/acre					
29	number/acre					
30	number/acre					
31	percent					
32	percent					
33	percent					

*See Table 16 for explanation of variable numbers.
**A blank indicates that a variable was not appropriate or could not be measured in the park subsection.

to have the lowest bird species diversity of any of the five parks studied (Table 2). People left food at the feeding station and were responsible for the waste which was spread over the park grounds; this food attracted very large numbers of only a few species. Further, because of the social problems associated with dense shrub plantings in downtown parks, no nest sites or cover were available for species of the lower strata; this acted to decrease the total number of species seen. Direct human disturbance seemed to have little effect on the starling, pigeon, and house sparrow, but it possibly had more influence on birds such as the cardinal and dove. This factor would further act to create conditions under which only a few species of birds could flourish.

Woodmere Subsection

Structurally, the Woodmere park study area was similar to Clark Park (Figures 4 and 7, Table 22); its total bird population estimate was, however, considerably lower both years (Table 6). The primary difference between these two areas was the lack of human disturbance in the Woodmere subsection, although it must be remembered that the total size of the cemetery was several times that of Clark Park. Without a large degree of human interference, the natural elements of the study area exerted their influence and produced a more diverse bird population.

Unlike the Clark subsection, the Woodmere plot was not used as extensively as a feeding area for birds of the surrounding neighborhood. The robin, pheasant, starling, blue jay, mourning dove, and yellow-shafted flicker, among others, nested in the cemetery, and several of these species were believed to nest in the study area itself. The fact that more birds bred in the area and fewer fed there may account, in part, for the lower total bird population found in the cemetery. It should be noted, however, that starlings, house sparrows, and ring-billed gulls were seen feeding there, although generally not in large numbers.

When one examines the list of birds found in the Woodmere park subsection (see Appendix E), it is immediately obvious that there are few species of the lower strata. Thus, the lack of vegetative volume within the zero to three-foot and four to 12-foot strata must have the effect of lowering the total number of avian species inhabiting the area. It is also true, however, that volume in the upper two strata (12 to 30 feet and above 30 feet) is also limited, especially when it is compared to that of the Ford park subsection (Table 22); therefore, it may also be related to the lower number of individuals seen in the cemetery. It appears that the lack of human disturbance allows the Woodmere area to reach its full avian potential; however, this potential is probably limited by the amount and structure of the vegetation present.

Ford Subsection

The avian population of the Ford woodlot was characterized by an extremely variable nature. The total population was not, on the average, very high (third lowest in 1972 and lowest in 1973); in addition, the standard deviation was large, which indicates that the number of individual birds observed each week varied greatly (Table 6). This instability is also reflected by the highly variable bird species diversity index (Table 2). Reference to Figures 20 and 21 shows that there is a marked seasonal trend in bird species diversity which coincides with the entrance and exit of migrants to and from the resident population. In the early spring, starlings extensively utilized cavities in old trees for nesting. The cardinal, blue jay, indigo bunting, wood duck, and pheasant were all known to nest in the woodlot, and no doubt many less conspicuous species did so as well. The number of resident birds seemed to be relatively low, thereby allowing the influx of migrants and other transients to greatly affect the weekly population estimates and bird species diversity indices.

It would seem that the structure of the Ford park subsection was ideal for attracting many migratory species of birds. This is probably due to the fact that many migrants are woodland species, and the Ford area had a very large volume of vegetation, particularly in the upper strata (Table 22). No other study area had such a large vegetative volume in its upper strata, as well as such a strong seasonal trend in bird species diversity and such a highly variable weekly population. The Ford woodlot (taken in its entirety) was also a monotypic forest type located in the middle of a considerably larger urbanized area. Thus, it might act as a magnet in attracting many species of birds.

Human interference in the Ford area was far less than that in the Clark Park subsection. It was limited almost solely to neighborhood children who concentrated their activities (e.g., motorbiking, hiking, building forts and trails) in the lower two strata of the park. This may be one factor which explains the smaller number of birds observed within the lower strata, even though a substantial volume of vegetation was present there (Table 22).

Golfview Subsection

On an overall basis, the population levels of the avifauna in the Golfview park subsection were the lowest of any of the five parks studied in 1972 and the second lowest in 1973 (Table 6). The bird species diversity index was second lowest in 1972 and the lowest of all park areas in 1973 (Table 2). However, as was noted earlier (see Study Areas), this subsection contained two distinct habitat types: a golf course and a small section of shrubs. Although the data presented in Table 22 represent a summation of both habitat types, these two types should be considered separately in order to clearly understand the situation within this subsection.

The golf course itself was distinguished by an almost total absence of birdlife. Many of the birds which were seen merely flew over the area without stopping in any part of it. Although it is of limited value as a feeding area, the golf course did act in this capacity to some extent. Robins were among the more frequently seen visitors to the area. During the spring migratory period, only a few warblers were observed in the groves of American elm present on the course. The shrubby area was primarily a breeding area for red-winged blackbirds and grackles. Cardinals, catbirds, and brown thrashers were also noted nesting in this area.

The variation in roles played by the golf course and the shrubby area is accounted for by their difference in structure. The golf course had essentially no vegetation below 12 feet and only a limited amount above that level. It did, naturally, have an expanse of lawn. The shrubby area was extremely dense below 12 feet and had several mature trees reaching into the upper stratum. Thus, there was essentially no habitat available for nest sites on the golf course itself and only limited habitat for displaying or perching, while conditions in the shrubby area were ideal for low-nesting species. It is not believed that human disturbance was a significant factor in discouraging birds on the golf course, since it was relatively void of the habitat needed to initially attract them.

Dearborn Subsection

The Dearborn park subsection had the highest bird species diversity during both years of study of any park area (Table 2), while its total bird population was second only to Clark Park (Table 6). However, because of the methodology involved, the bird population levels for the Dearborn area were probably underestimated. This area also had the highest number of species of birds (see Table 4 and Appendix E).

As was the case in the Golfview park, the Dearborn subsection was a composite of two habitat types (see Study Areas). This area was the most vegetatively complex park studied and was also part of a much larger county park system. These factors are no doubt responsible for the diverse avifauna which was present. Human interference was minimal because the undergrowth was extremely thick and contained an abundance of poison ivy and stinging nettles.

During the spring migratory period, many species of birds visited the Dearborn park subsection on their way north. This is one factor which caused the standard deviation of the mean bird population estimate to be relatively large. Field work indicated that the Dearborn park had the largest number of breeding birds of any area studied. Many low and even ground-nesting species found excellent cover in the dense shrub growth surrounding the residential subsection, while species which nest at higher elevations found cover in the lowland woods which bordered the creek. Reference to Table 22 shows that the average volume of vegetation in the four height strata are comparable to the other park subsections, excluding the Ford area; thus, volume alone cannot account for the extensive utilization of this area by birds. It is believed that it is not only vegetative volume, but also the arrangement of that volume which is important in attracting such a wide variety of birdlife.

INTERRELATIONSHIP OF RESIDENTIAL AND PARK SUBSECTIONS

Although this study was not designed to identify the effects of a park on the surrounding neighborhood, or vice versa, some information on this subject was gathered. Within the Clark study plot, the park subsection was definitely used as a feeding area by birds of the surrounding residential area. There was little or no use of the residential subsection by birds of the park; in fact, there were essentially no birds which spent most of their time in the park area.

The Woodmere Cemetery also served as a feeding area for birds of the surrounding neighborhood, although to a lesser extent. Unlike Clark Park, the cemetery did have its own resident bird population. When one compares the species lists of the residential and park subsections (Appendix E), however, evidence suggests that there was minimal movement from the cemetery to the residential subsection.

Within the Ford study area, there did seem to be an interplay in both directions between the park and residential subsections; the extent of this movement was not fully detected because the study was not designed to measure it. In the early spring many starlings nested in the woodlot, and those seen in the residential area are probably the same birds, plus a few individuals which nested in the residential subsection itself; many of these birds were seen flying back and forth between the woodlot and the residential area. Individuals of several species nested along the interface of the two subsections and probably included both in their home range.

As was noted earlier (see Analysis of the Relationship between Park Habitat and Birdlife), grackles and red-winged blackbirds nested extensively in the shrubby area of the Golfview park subsection. These birds were seen flying between the park and residential subsections on nearly every census. Another species which utilized both subsections was the robin. Several of these birds which nested along the interface of the two subsections were observed feeding on the lawn area of the golf course; when they were disturbed, they returned to the bordering neighborhood.

The Dearborn area was the only one in which there seemed to be an enrichment of birdlife in the residential area as a result of the bordering park. Many more species of birds were seen in the residential subsection than one might expect from examining its structure alone. Residents maintained at least two year-round feeding stations and nest boxes, which helped to attract birds from the surrounding woods. On one occasion a mallard was even seen circling the area and subsequently landing in a swimming pool. It was difficult to determine the extent to which birds of the residential area inhabited the park subsection. On several occasions, house sparrows were seen in the park, but is is not known whether they nested there or in the residential area.

In conclusion, it would seem that there is indeed an interaction of birds between parks and the residential areas that surround them. The type and extent of this interaction seems to depend upon the type of park and residential area involved.

FALL AND WINTER BIRD SURVEY RESULTS

Table 23 lists those birds seen in each study area during the fall, 1972, and winter, 1973, bird surveys by season and subsection. Both the total number of birds and their breakdown into the number of year-round, winter, spring-summer-fall, and uncommon species seen in each area are also presented in Table 23. The mean bird species diversity for the fall and winter surveys is presented in Table 24; the average 1973 spring-summer diversity indices are also listed in this table for purposes of comparison.

All birds listed in Table 23 were observed during the fall survey, while only 15 of those recorded were seen during the winter period. Of those birds listed in this table, eight were seen on a year-round basis, six were observed only during the winter months, 14 were observed primarily in the spring, summer, or fall, and two (the barred owl and the brown-capped chickadee) were considered uncommon species in the Detroit area (O'Reilly, Kelley, and Kelley, 1960). Of the latter group, the barred owl was also present in the Dearborn park subsection during the spring and summer surveys, while the brown-capped chickadee was not.

Bird species diversity was usually higher in the fall months than it was during the winter period; however, the Clark and Woodmere residential subsections were exceptions to this generalization. It may further be noted that bird species diversity was generally about the same for the fall and spring-summer periods. These results are largely to be expected, since during both the spring-summer and fall survey

Table 23. Birds occurring within the five study areas during the fall (1972) and winter (1973) periods.

Species	Clark F*		Clark W		Woodmere F		Woodmere W		Ford F		Ford W		Golfview F		Golfview W		Dearborn F		Dearborn W	
	**P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R
House Sparrow	x	x	x	x		x	x			x		x		x		x	x	x		x
Starling	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Grackle						x			x	x			x	x			x	x		
Pigeon		x		x	x	x	x	x								x		x		
Robin					x					x				x			x			
Slate-colored Junco	x	x			x								x	x	x	x	x		x	
Blue Jay	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Yellow-bellied Sapsucker		x																		
Cardinal					x				x	x		x	x	x	x	x	x	x	x	
Brown Thrasher					x															
Yellow-shafted Flicker					x				x				x	x						
White-throated Sparrow	x				x	x			x								x	x		
Mourning Dove										x	x			x	x	x	x	x	x	x
Goldfinch										x			x	x			x		x	
Pheasant													x						x	
Hairy Woodpecker	x																	x	x	
Cedar Waxwing														x			x			
Mallard																	x			
Crow													x							
Olive-backed Thrush		x			x					x										
Song Sparrow					x												x		x	
Downy Woodpecker											x						x			
Myrtle Warbler						x											x			
Tufted Titmouse																	x		x	
Ruby-crowned Kinglet																	x			
Barred Owl																	x			
White-breasted Nuthatch					x									x			x		x	
Black-capped Chickadee																	x		x	

Table 23 (cont'd).

Species	Clark				Woodmere				Ford				Golfview				Dearborn			
	F		W		F		W		F		W		F		W		F		W	
	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R
Brown-capped Chickadee																	x			
Fox Sparrow																	x			
Total	6	7	2	3	11	7	3	4	6	9	4	4	9	12	5	7	22	9	12	4
Year-round residents	3	4	2	3	3	4	3	4	3	5	2	4	6	5	3	5	5	5	5	3
Spring-summer-fall residents	2	2			6	3			3	4	1		2	5	1	1	9	3	2	1
Winter residents	1	1			2						1		1	2	1	1	6	1	5	
Uncommon species																	2			

* F indicates fall survey; W indicates winter survey.
** P indicates park subsection; R indicates residential subsection.

periods year-round and summer residents, as well as migrants, are likely to be present. During the winter months, however, one would generally expect to see only year-round and winter residents.

Although data for the fall and winter surveys was insufficient to determine whether significant differences existed between the diversity indices of the individual study areas, they can be compared (Table 24). When one compares the order of the diversity indices for the spring-summer and fall periods, it can be seen that it is exactly the same for the residential subsections; the park subsections are alike with the exception of a reversal in the order of the values for the Golfview and Clark areas. When the spring-summer and winter periods are compared, however, there is a wider divergence in the order in which both the residential and park subsections fall. Thus, in winter the Ford residential subsection is less diverse than the Woodmere area, while during the spring-summer period it is more diverse. Also, although the Golfview park subsection is more diverse in winter than the Ford park area, it is less diverse during the spring-summer months.

Table 24. Seasonal bird species diversity indices for the five study areas.

Season	Clark	Woodmere	Ford	Golfview	Dearborn
			Residential Subsections		
Fall (1972)	.88432	.76794	1.60708	1.62247	1.69965
Winter (1973)	.89421	.86088	.72313	.96366	.94804
Spring-Summer (1973)	1.14305	1.23104	1.62545	1.67452	1.67766
			Park Subsections		
Fall (1972)	1.45517	2.08137	1.66746	1.21993	2.02772
Winter (1973)	.22528	.31826	.86756	.95000	1.75725
Spring-Summer (1973)	1.09837	1.64216	1.51427	1.41756	2.31197

COMPARISON OF THE USEFULNESS OF THE TRANSECT AND TIME-AREA SURVEY TECHNIQUES FOR URBAN BIRD STUDIES

During the course of this study, two methods of censusing birds were utilized (see Methods). Although yearly differences in the actual bird populations made comparison of the methods difficult, there were, none-the-less, obvious differences between them.

As was noted earlier (see Analysis of the Interrelationship between Residential Habitat and Birdlife), the transect method of bird censusing resulted in higher coefficients of determination (R^2). These higher R^2 values were attributed to the fact that there was less variance in the weekly bird population estimates when the transect method was used. This is, of course, a distinct advantage when one wants to account for differences in population levels, as was the case in the present study.

The results also indicated that bird population estimates for 1972 and 1973 were predicted at two distinct levels (see Spring-Summer Bird Surveys). The difference between years was so great that it was attributed to the methodology and not solely to a change in actual population levels. The transect counts consistently gave lower population estimates than did the time-area method. The estimates predicted by the time-area counts were closely related to Woolfenden and Rohwer's (1969) estimate of breeding-bird populations in three Florida suburbs. Smith's (1971) estimate of breeding birds in Reston, Virginia, and Simmers' (1965) estimate for a residential area of Ithaca, New York, more closely agree with the population figures calculated by the transect method. Thus,

until more studies are available for comparison, it is questionable which study method results in the most accurate population prediction.

Primarily, the time-area method was utilized in 1973 because it was felt that many of the smaller, less conspicuous birds were missed in 1972. The results showed, however, that in the majority of subsections, more species were seen using the transect method than were observed with the time-area method. Within the park subsections, anywhere from three to ten more species of birds were seen in 1972 than in 1973. Within the residential areas, both methods seemed to detect approximately the same number of species.

There were also some differences in methodology which were related to the human factor. Although each method could be conducted with relatively little human disturbance in the morning, this was not true for the time-area method during the evening. In fact, data was nearly impossible to gather in the evening when time-area counts were used because of the constant questioning of the author by residents. Further, more than once a census point coincided with a group of children playing ball.

It is the conclusion of the author that the transect method of censusing birds is best suited for work in an urban environment. When compared with the time-area method, this method gave less variable results, was as good or better (in urban parks) in detecting inconspicuous species, and resulted in less disruptive interaction with the residents of the study areas. The transect method also appears to give a more conservative estimate of the bird population under study than does the time-area census technique.

QUESTIONNAIRE

Introduction

The questionnaire and letter of introduction which were utilized in this study are reproduced in Appendix B; the results are listed in Tables 25 through 29. It was initially determined that 25 percent of the houses in each of the five study areas would be sampled. However, because of both time and financial limitations, a smaller percentage was sampled in the Clark (19.59 percent) and Woodmere (12.20 percent) areas. Sample size in the Ford and Golfview areas was felt to be sufficient (25.26 percent and 32.56 percent, respectively). Within the Dearborn area, 92.31 percent of the houses were sampled; however, this figure represents only 12 houses.

A questionnaire was circulated during this study for several reasons: to gather information about the attitudes of residents of each study area toward the birds they see in their yards; to gather background data, such as the number of cats and dogs, which may be related to bird species diversity or bird abundance levels; and to further acquaint the residents of each study area with the project. Both parts of the questionnaire are discussed separately below.

Background Questions

Questions 1, 2, 3, and 4 (see Appendix B) were designed to give an insight into the nature of the person being interviewed, and they were used in describing the type of people living in the residential subsection

Table 25. Questionnaire results for the Clark area.

Background Questions

1. Occupation:

Non-professional	47.37%
Professional	5.26%
Housewife	26.32%
Student	5.26%
Retired	15.79%

	YES	NO
2. Participates in outdoor activities:	36.84%	63.16%
3. Has a garden:	42.11%	57.89%
4. Uses pesticides:	15.79%	84.21%
5. Has a cat:	15.79%	84.21%
6. Has a dog:	42.11%	57.89%

7. Number of adults (16 and over): 42 or 2.21 per house

8. Number of children (15 and under): 25 or 1.32 per house

Questions on Attitude

	YES	NO
1. Feeds birds:	52.63%	47.37%
2. Provides water for birds:	21.05%	78.95%
3. (a) Provides nest boxes:	0%	100%
(b) Number provided:		
4. (a) Watches birds:	94.74%	5.26%

(b) How often:

Rarely	11.12%
Occasionally	44.44%
Often	44.44%

	YES	NO
5. (a) Do birds use house for nesting or roosting:	21.05%	78.95%

(b) Where do they nest:

Area	Number of Responses
Front Porch	1
Eaves	1
Gutter	1

(c) Where do they roost:

Area	Number of Responses
Roof	1
Eaves	1
Gutter	1

	YES	NO
6. (a) Do birds use other parts of your yard for nesting:	26.32%	73.68%

(b) Where do they nest:

Area	Number of Responses
Trees	2

Table 25 (cont'd).

7. Birds residents enjoy seeing most (ten most frequently mentioned species):

Species	Number of Responses
Blue Jay	11
Robin	11
Cardinal	10
House Sparrow	5
Goldfinch	4
Pigeon	2
Hummingbird	2
Mourning Dove	2
Pheasant	2
Ducks	2

8. Birds residents enjoy seeing least (all responses included):

Species	Number of Responses
Pigeon	21
Starling	5
Grackle	3
House Sparrow	3
Crow	2
Mourning Dove	1
None	3

9. (a) Discourage birds on property:

YES	NO
5.26%	94.74%

(b) How are birds discouraged:

Method	Number of Responses
---	---

(c) Birds discouraged:

Species	Number of Responses
---	---

10. Attitude toward birds:

Dislike	Indifferent	Like
0%	21.05%	78.95%

Table 26. Questionnaire results for the Woodmere area.

Background Questions

1. Occupation:

Non-professional	30%
Professional	10%
Housewife	55%
Student	0%
Retired	5%

		YES	NO
2.	Participates in outdoor activities:	70%	30%
3.	Has a garden:	50%	50%
4.	Uses pesticides:	40%	60%
5.	Has a cat:	10%	90%
6.	Has a dog:	75%	25%

7. Number of adults (16 and over): 59 or 2.95 per house

8. Number of children (15 and under): 24 or 1.20 per house

Questions on Attitude

		YES	NO
1.	Feeds birds:	55%	45%
2.	Provides water for birds:	10%	90%
3.	(a) Provides nest boxes:	10%	90%
	(b) Number provided: 1		
4.	(a) Watches birds:	100%	0%

(b) How often:

Rarely	10%
Occasionally	75%
Often	15%

		YES	NO
5.	(a) Do birds use house for nesting or roosting:	25%	75%

(b) Where do they nest:

Area	Number of Responses
Eaves	3
Gutter	1

(c) Where do they roost:

Area	Number of Responses
Eaves	3
Roof	2

		YES	NO
6.	(a) Do birds use other parts of your yard for nesting:	20%	80%

(b) Where do they nest:

Area	Number of Responses
Trees	3

Table 26 (cont'd).

7. Birds residents enjoy seeing most (ten most frequently mentioned species):

Species	Number of Responses
Cardinal	13
Robin	13
House Sparrow	9
Blue Jay	8
Pheasant	5
Hummingbird	4
Woodpecker	3
Geese	3
Hawks	2
Red-winged Blackbird	2

8. Birds residents enjoy seeing least (all responses included):

Species	Number of Responses
Pigeon	12
Grackle	8
Starling	7
Crow	5
House Sparrow	3
Blue Jay	1
None	2

	YES	NO
9. (a) Discourage birds on property:	20%	80%

(b) How are birds discouraged:

Method	Number of Responses
Wash with water	2
Chase away	1
Screen in holes	1

(c) Birds discouraged:

Species	Number of Responses
Pigeon	1
Grackle	1

10. Attitude toward birds:

Dislike	Indifferent	Like
0%	20%	80%

Table 27. **Questionnaire results for the Ford area.**

Background Questions

				YES	NO
1.	Occupation:	Non-professional	37.50%		
		Professional	20.83%		
		Housewife	37.50%		
		Student	4.17%		
		Retired	0%		
2.	Participates in outdoor activities:			62.50%	37.50%
3.	Has a garden:			70.83%	29.17%
4.	Uses pesticides:			20.83%	79.17%
5.	Has a cat:			8.33%	91.67%
6.	Has a dog:			33.33%	66.67%
7.	Number of adults (16 and over): 64 or 2.67 per house				
8.	Number of children (15 and under): 24 or 1.00 per house				

Questions on Attitude

				YES	NO
1.	Feeds birds:			58.33%	41.67%
2.	Provides water for birds:			25.00%	75.00%
3.	(a) Provides nest boxes:			4.17%	95.83%
	(b) Number provided: 1				
4.	(a) Watches birds:			95.83%	4.17%
	(b) How often:	Rarely	4.17%		
		Occasionally	33.33%		
		Often	62.50%		
5.	(a) Do birds use house for nesting or roosting:			58.33%	41.67%

(b) Where do they nest:

Area	Number of Responses
Garage	7
Gutter	2
Porch	2
Chimney	1
Attic vent	1
Awning	1
Grapevine	1
Eaves	1

(c) Where do they roost:

Area	Number of Responses
Garage	4
Porch	2
Roof	1
Gutter	1
Grapevine	1
Eaves	1
Chimney	1
Awning	1

Table 27 (cont'd).

		YES	NO
6. (a)	Do birds use other parts of your yard for nesting:	66.67%	33.33%

(b) Where do they nest:

Area	Number of Responses
Trees	17
Bushes	1

7. Birds residents enjoy seeing most (ten most frequently mentioned species):

Species	Number of Responses
Cardinal	23
Blue Jay	15
Robin	12
Mourning Dove	9
House Sparrow	7
Grackle	5
Baltimore Oriole	4
Woodpecker	3
Hummingbird	2
Red-winged Blackbird	2

8. Birds residents enjoy seeing least (all responses included):

Species	Number of Responses
Grackle	11
Blue Jay	8
House Sparrow	7
Pigeon	3
Starling	3
Crow	2
Cowbird	1
None	5

		YES	NO
9. (a)	Discourages birds on property:	8.33%	91.67%

(b) How are birds discouraged:

Method	Number of Responses
Chase away	1
Destroy nests	1

(c) Birds discouraged:

Species	Number of Responses
Blue Jay	2

10. Attitude toward birds:

Dislike	Indifferent	Like
0%	16.67%	83.33%

Table 28. Questionnaire results for the Golfview area.

Background Questions

1. Occupation:

Non-professional	21.43%
Professional	50.55%
Housewife	28.57%
Student	0%
Retired	0%

	YES	NO
2. Participates in outdoor activities:	50.00%	50.00%
3. Has a garden:	100.00%	0%
4. Uses pesticides:	57.14%	42.86%
5. Has a cat:	21.43%	78.57%
6. Has a dog:	42.86%	57.14%

7. Number of adults (16 and over): 42 or 3.00 per house

8. Number of children (15 and under): 16 or 1.14 per house

Questions on Attitude

	YES	NO
1. Feeds birds:	64.29%	35.71%
2. Provides water for birds:	42.86%	57.14%
3. (a) Provides nest boxes:	42.86%	57.14%

(b) Number provided: 14 or 1 per house

	YES	NO
4. (a) Watches birds:	100.00%	0%

(b) How often:

Rarely	0%
Occasionally	50%
Often	50%

	YES	NO
5. (a) Do birds use house for nesting or roosting:	7.14%	92.88%

(b) Where do they nest:

Area	Number of Responses
Awning	1

(c) Where do they roost:

Area	Number of Responses
Awning	1

	YES	NO
6. (a) Do birds use other parts of your yard for nesting:	78.57%	21.43%

(b) Where do they nest:

Area	Number of Responses
Trees	10
Shrubs	3

Table 28 (cont'd).

7. Birds residents enjoy seeing most (ten most frequently mentioned species):

Species	Number of Responses
Cardinal	13
Blue Jay	9
Robin	4
Mourning Dove	4
Baltimore Oriole	4
House Sparrow	2
Wren	2
Pheasant	2
Hummingbird	2
Chickadee	1

8. Birds residents enjoy seeing least (all responses included):

Species	Number of Responses
Starling	7
Grackle	6
House Sparrow	5
Blue Jay	1
Robin	1
None	3

	YES	NO
9. (a) Discourage birds on property:	14.29%	85.71%

(b) How are birds discouraged:

Method	Number of Responses
Destroy nests	1
Plastic owls	1

(c) Birds discouraged:

Species	Number of Responses
House Sparrow	1
Grackle	1

10. Attitude toward birds:

Dislike	Indifferent	Like
0%	21.43%	78.57%

Table 29. Questionnaire results for the Dearborn area.

Background Questions

1. Occupation:

Non-professional	0%
Professional	58.33%
Housewife	41.67%
Student	0%
Retired	0%

	YES	NO
2. Participates in outdoor activities:	41.67%	58.33%
3. Has a garden:	83.33%	16.67%
4. Uses pesticides:	75.00%	25.00%
5. Has a cat:	8.33%	91.67%
6. Has a dog:	50.00%	50.00%

7. Number of adults (16 and over): 31 or 2.58 per house

8. Number of children (15 and under): 18 or 1.50 per house

Questions on Attitude

	YES	NO
1. Feeds birds:	75.00%	25.00%
2. Provides water for birds:	25.00%	75.00%
3. (a) Provides nest boxes:	41.67%	58.33%

(b) Number provided: 6 or 1.20 per house

	YES	NO
4. (a) Watches birds:	100.00%	0%

(b) How often:

Rarely	0%
Occasionally	16.67%
Often	83.33%

	YES	NO
5. (a) Do birds use house for nesting or roosting:	41.67%	58.33%

(b) Where do they nest:

Area	Number of Responses
Gutter	3
Roof	1
Vent	1
Chimney	1

(c) Where do they roost:

Area	Number of Responses
Television Antenna	3
Roof	1
Chimney	1

	YES	NO
6. (a) Do birds use other parts of your yard for nesting:	83.33%	16.67%

(b) Where do they nest:

Area	Number of Responses
Trees	9
Shrubs	2

Table 29 (cont'd).

7. Birds residents enjoy seeing most (ten most frequently mentioned species):

Species	Number of Responses
Cardinal	7
Blue Jay	5
Goldfinch	5
Pheasant	4
Robin	3
Bluebird	2
Woodpecker	2
Chickadee	2
Baltimore Oriole	2
Mallard	2

8. Birds residents enjoy seeing least (all responses included):

Species	Number of Responses
Grackle	5
House Sparrow	4
Pigeon	3
Blackbirds	2
Blue Jay	1
Mourning Dove	1
Red-winged Blackbird	1
Cowbird	1
Crow	1
None	2

	YES	NO
9. (a) Discourages birds on property:	8.33%	91.67%

(b) How are birds discouraged:

Method	Number of Responses
Shooting	1

(c) Birds discouraged:

Species	Number of Responses
Grackle	1
Cowbird	1
Blackbirds	1

10. Attitude toward birds:

Dislike	Indifferent	Like
0%	0%	100%

of each study area (see Study Areas). These questions were also used by Schmidt (1974) in his comparison of the attitudes of study area residents toward ten selected birds and mammals. The information gathered in questions 5, 6, 7, and 8 (see Appendix B) was converted to a per-acre base and used as independent variables (X_{25}, X_{26}, X_{27}, and X_{28}, respectively) in the regression analysis (Table 16). Question 3b under Questions on Attitude was also used as an independent variable (X_{29}) in the regression analysis.

Questions on Attitude

The first three questions under Questions on Attitude (see Appendix B) sought to determine what percentage of the population of each study area encouraged birds by providing food, cover (i.e., nest boxes), and/or water. The results of these questions are cited in Tables 25 through 29. In order to compare the degree of encouragement offered in each neighborhood, the percentage values for each of the first three questions were added together to give one "encouragement value." A value of 300 represents a maximum degree of encouragement, while zero represents none at all. The encouragement values for the five study areas are: Clark area, 73.68; Woodmere area, 75.00; Ford area, 87.50; Golfview area, 150.01; and Dearborn area, 141.67. These results tend to show that there is an increasing degree of encouragement as one moves from the center city to the suburbs. Further, it can be noted that there is a large jump in values between the first three study areas and the latter two.

There could be several reasons for the wide divergence in encouragement values between the Clark, Woodmere, and Ford areas and the Golfview and Dearborn areas. First, if people are rewarded in their efforts to encourage birds by seeing desirable species, then they are more likely to continue to feed them and provide nest sites or water than if they are not so rewarded. Secondly, there is an economic consideration; those people who can afford to encourage birds are more likely to do so than those who cannot. Finally, there is also a psychological factor whereby a person must be motivated in order to devote time and money to birdlife.

The first argument cited above seems to hold true for the Clark, Woodmere, Golfview, and Dearborn areas, but not for the Ford area. In the Clark and Woodmere areas, there are very few desirable birds (cardinals and blue jays); thus, attempts to attract these species would prove frustrating, causing encouragement to stop. In the Golfview and Dearborn areas desirable species are present, so attempts to attract them would prove fruitful and would, therefore, continue. However, in the Ford area a low encouragement value was recorded even though desirable species were present in numbers high enough to respond to encouragement; therefore, a different factor must be responsible for the low encouragement value found here.

It is an economic fact that if one has a limited income, he will distribute it on a priority basis. Thus, if one cannot afford to encourage birds, he will not do so. In the Clark, Woodmere and Ford areas non-professional workers outnumber professional people (Tables 25 through 27); this means that there is probably a lower income level in these three areas than in the Golfview and Dearborn study plots. The higher income level of the latter two areas permits the residents to encourage birds, whereas the opposite is true in the Clark, Woodmere, and Ford plots. Thus, economic considerations might explain why people living in the Ford area do not encourage birds, even though doing so would result in their seeing desirable species.

The final factor is a psychological one, which in effect controls considerations of both time and money by placing a value on birds which is either above or below that of other factors. Thus, the amount of time and money a person spends on encouraging and/or watching birds depends upon their relative importance to him. In the Clark, Woodmere, and Ford areas the majority of people are workers who seem to value birds below other considerations; therefore, they do not encourage them to a great degree. People in the Golfview and Dearborn areas, on the other hand, seem to value birds more highly, spending both time and money to encourage them.

The factors discussed above which cause one neighborhood to have a higher encouragement value than another will act together rather than singly. Thus, a person must have a psychological desire to see birds, which in turn will allow him to allocate both time and money to fulfill that desire. He must further, however, be rewarded in his efforts to encourage birds by seeing desirable species.

Questions 4, 5, and 6 (see Appendix B) sought to determine the degree to which people observe birds in their yards. When asked whether or not they watched birds, over 95 percent of the people in each study area responded in the affirmative. However, when asked whether they watched birds rarely, occasionally, or often (Appendix B, Question 4b), it was only in the Ford and Dearborn areas that the majority of residents watched birds often. In the Woodmere area the majority watched birds occasionally, while in the Clark and Golfview areas the residents were split evenly between occasionally and often.

The reliability of the answers given for question 4b can be tested by comparing them with the answers given for questions 5 and 6 (see

Appendix B). Both of these latter questions deal with the residents' awareness of the birds in their yards; thus, the sum of the affirmative answers to these questions may be considered as representing an awareness value. The maximum awareness value is 200 and the minimum is zero. These values were calculated to be 47 for the Clark area, 45 for the Woodmere area, 125 for the Ford area, 85 for the Golfview area, and 124 for the Dearborn area. These figures show that the study areas exhibiting the highest awareness values are the same ones in which a majority of the people watched birds often (i.e., the Ford and Dearborn areas). The awareness values are lowest in the Clark and Woodmere study plots. This is to be expected in the Woodmere area; however, based upon the results of question 4b, one would expect a higher awareness value for the Clark area. An intermediate awareness value was recorded in the Golfview area, where the residents were split evenly between watching birds occasionally and often. Therefore, with the exception of the Clark study plot, the answers to question 4b do represent a reliable indication of the relative extent to which people watch birds in their neighborhood. Within the Clark area the results tend to show that people watched birds less than they indicated on the questionnaire.

Questions 7 and 8 (see Appendix B) were designed to determine which birds people enjoyed seeing most and which they enjoyed seeing least. These questions allowed a person to include any bird which he liked or disliked, since responses were not limited to only those birds which residents saw in their immediate yards. Thus, although the hummingbird was only observed by the author in the Ford park subsection, it nonetheless ranked as one of the top ten favorite birds in four of the five study areas.

When one examines the answers to question 7 (Tables 25 through 29), it is immediately apparent that the residents of each area considered the cardinal, blue jay, and robin to be highly desirable species. The cardinal was never ranked below third place, the blue jay was never below fourth place, and the robin was never below fifth place. These three birds have several things in common which could account for their popularity. Each of these species is highly observable and each is colorful, although the robin is less so than the cardinal or blue jay; the duller color of the robin may, in part, account for its slightly lower ranking. A further attribute is that each of these species is very vocal, with the cardinal and robin having very melodious songs. It should be noted that there was no relationship between the abundance levels of the cardinal, blue jay, and robin and their popularity with the residents of each neighborhood. These species were just as popular in the Clark and Woodmere areas, where they were uncommon, as in the remaining areas, where they were more abundant.

The purpose of question 8 was to determine which avian species were least popular. In the Clark and Woodmere areas the pigeon seemed to be the least popular bird. When population levels are considered, it can be seen that these areas had the highest numbers of pigeons. Further, because of the architecture of the houses in these two neighborhoods, pigeons were most often seen roosting on roofs and under eaves, causing sanitation problems for the residents. Grackles and starlings were the least popular birds in the remaining neighborhoods. They were generally common to abundant and often roosted in large numbers in yard trees, causing sanitation and noise problems.

The house sparrow was also an unpopular bird, but since it may not have caused as serious sanitation or noise problems, it was not as unpopular as the pigeon, grackle, and starling. When one compares the attitude of residents toward the house sparrow, it can be seen that this species was generally more popular than unpopular in the Clark and Woodmere areas, while the opposite was true in the Ford, Golfview, and Dearborn study plots. This might be explained by the fact that inner-city residents do not have as many species of birds living in their neighborhoods, so they value the house sparrow more highly because it is a bird with which they are very familiar.

Several management recommendations may be made on the basis of the answers given to questions 7 and 8. First, the cardinal, blue jay, and robin should be considered as prime candidates for management in the city, since they are valued as highly desirable species by each segment of the population. Secondly, the pigeon, grackle, and starling seem to be universally disliked, and management should seek to reduce their numbers. The house sparrow seems to be both liked and disliked; perhaps a reduction in its numbers would help to ameliorate some of the problems it causes without eliminating the enjoyment it gives to many people.

The purpose of question 9 (see Appendix B) was to determine what percentage of the residents of each study area discouraged birds, how they discouraged them, and which birds were involved. The percentage of people discouraging birds was generally low and is not inversely related to the encouragement values calculated above. In the Woodmere area, 20 percent of the people did discourage birds. Two years of field work and numerous conversations with residents indicated that the pigeon was the species most often discouraged. Other birds that were discouraged are listed in Tables 25 through 29. Sample size was not large enough to make generalizations as to other species that were discouraged in other neighborhoods. Responses concerning methods of discouraging were also small in number. The most frequent methods used were chasing, washing with water, and destroying nests. One person indicated that he shot undesirable species.

Question 10 (see Appendix B) sought to determine whether people liked, disliked, or were indifferent to the birds they saw in their yards. The answers to this question seem to indicate that birds are overwhelmingly liked in each neighborhood (Tables 25 through 29). None of the residents of any study plot indicated that as a group they disliked the birds they saw in their yards. Further, it was found that only 16 to 21 percent of the respondents in the Clark, Woodmere, Ford, and Golfview areas were indifferent to the birds they saw. All people interviewed in the Dearborn area indicated that they liked birds.

The results of the questionnaire seem to suggest that most people, regardless of the area in which they live, like to see birds, and that the cardinal, blue jay, and robin are the species they enjoy seeing most. Generally, people in the inner-city watched birds less than those in the suburbs; this is further reflected in the fact that they usually did not encourage birds as much as suburbanites. However, although inner-city residents did not encourage birds as extensively as residents of other study areas, it is not true that they discouraged them more.

MANAGEMENT AND FUTURE RESEARCH

Residential Subsections

Because this study is one of the first of its kind, and because the habitat variables measured accounted for a maximum of only 59.38 percent of the variance in any dependent variable, a long list of definitive management procedures cannot be given. However, the results of this study do allow certain generalizations to be made, and they also indicate areas in which future research might be conducted.

The results of this study make it possible to suggest several management recommendations which are especially applicable to new subdivision design. This is true because effecting a significant change in the value of any of the dependent variables would require a large change in the structure of the neighborhood involved (i.e., changing the volume of buildings and vegetation). It should be noted that one cannot necessarily utilize the regression equations cited earlier (Tables 20 and 21) beyond the upper and lower limits of the values of the variables used to derive the equations in the present study.

Perhaps the most desirable overall dependent variable to manage for is bird species diversity; this is also the variable which had the highest coefficient of determination in 1972 and 1973 (59.38 and 56.33 percent, respectively). Within any urban environment, an increase in bird species diversity would almost surely result in a smaller number of individuals of such undesirable species as the house sparrow, starling, and grackle (see Questionnaire); it would also act to increase the number of species present. Although a large part of the variation in bird species diversity was unexplained, it would seem that if a neighborhood with a relatively low volume of houses and a high volume of deciduous vegetation could be designed, there would be an increase in bird species diversity. The present study suggests that the volume of houses should not exceed 115,000 cubic feet per acre (the volume of the Ford and Golfview residential subsections) if a reasonable amount of bird species diversity is to be achieved. An attempt might also be made to maintain a deciduous volume which is at least equal to the volume of houses present; ideally, the deciduous volume should be one and one-half to two times greater than the volume of buildings. According to the 1972 regression data, it would also be desirable to include some areas of herbaceous growth other than grass. This could take the form of untended areas under bushes at yard borders. The data suggest that this value should equal approximately 12 percent of the figure for the volume of buildings per acre.

Finally, in order to find an acceptable subdivision design, a minimum acceptable value for the bird species diversity index must be chosen. The present study indicated that a value of 1.75 (that of the Golfview area in 1972 and the Ford area in 1973) represents such a figure. At this level there was a decrease in house sparrow numbers and an increase in the total number of species seen. Thus, using the parameters cited above and the regression formula derived for the 1972 data [Bird Species Diversity = 1.68730154 + Volume of Deciduous Vegetation (.00000136) + Volume of Buildings (-.00000495) + Area of Herbaceous Growth (.00026665)], one may proceed to design a subdivision with a bird species diversity of 1.75 or greater.

For example, if a particular design called for a volume of buildings of 100,000 cubic feet per acre, a deciduous volume of 200,000 cubic feet per acre, and an area of herbaceous growth of 1,200 square feet per acre, a bird species diversity index of 1.78428 would be expected. It should be noted, however, that since there is a relatively large amount of unexplained variation in bird species diversity in the present study, the actual index in this example would also depend upon variables other than those measured by the author.

In order to estimate the population levels of cardinals and mourning doves (the only two species for which the R^2 value was above 50 percent) in the present hypothetical subdivision, one additional criterion must be known: the volume of coniferous vegetation in the 13 to 30-foot stratum. Within the Golfview area where cardinal numbers were highest, this value was six percent of the figure for the volume of buildings. Thus, in the present example using the 1972 regression data, if there were 100,000 cubic feet of buildings and 6,000 cubic feet of coniferous volume within the 13 to 30-foot stratum, a cardinal population of .1676 birds per acre could be expected. This represents a population of the same magnitude as that found in the Golfview area. The dove population in this subdivision might be expected to be .2277 birds per acre; this is roughly the same number of mourning doves as was found in the Golfview and Dearborn residential subsections.

The present study has shown that certain relationships seem to exist between the eight dependent variables and some of the 20 independent variables measured. R^2 values were, however, not as high as would be desirable; thus, future research must seek additional habitat variables which will account for a substantial part of the unexplained variation. This is especially true for the cardinal, blue jay, and robin, which were designated as very desirable species by the residents of each study area. This study indicates that the volume of buildings is a very important habitat component: it appears to be related to all eight dependent variables. Future research must determine which particular component of the volume of buildings is related to urban birdlife. The structure of urban buildings should be separated into its various components to see if some feature such as architectural style, type of building material, number of stories, proximity of other buildings, roof design, and/or the number of possible nesting and roosting sites per cubic foot is of critical importance to avifauna. The volume of all deciduous vegetation was also an important variable in this study, but the particular strata chosen did not seem to be important to any of the species of birds studied. Future research is also needed to determine which component of the total deciduous volume is responsible for variation in bird numbers. It must be remembered, however, that more precision will require an increase in the amount of work and expense.

Park Subsections

It is not possible to suggest specific management plans for the park subsections because the same system of data analysis used in the residential areas could not be used here. However, some management proposals of a general nature relating to each of the five parks may be made; these are discussed below.

Clark Subsection

The Clark Park subsection had the lowest bird species diversity index and the highest total bird population estimate of any of the five parks (Tables 2 and 6). Ideally, an increase in bird species diversity would be achieved by lowering the number of individuals of the few species represented and by introducing more species to the area. However, this could not readily be accomplished because of the basic role that the park plays for residents of the surrounding neighborhood. This park acts as an area for both passive and active recreation. In the former case, residents, especially older people, relax on park benches; in the latter case, children, including those in physical education classes at a neighboring high school, play ball and engage in other disruptive activities. Thus, it is not possible, for example, to plant shrubs, since they might either serve to conceal would-be muggers or be destroyed by the activities of children. Perhaps management for birds in this area should concentrate on maintaining both the present overstory and the feeding station. If this is done, residents would be able to enjoy the birds which utilize the feeders, and the overstory could provide both limited nesting habitat and escape cover when feeding is disturbed.

Woodmere Subsection

The Woodmere park subsection had the third highest bird species diversity in 1972 and the second highest in 1973 (Table 2). The total bird population of the area was at an intermediate level (Table 6). As was the case with the Clark Park subsection, the primary function of the area must take precedence over management of birdlife. For instance, it is not feasible to create large areas of dense, woody undergrowth, nor is it possible to leave dead trees standing to act as habitat for cavity-nesting species.

Management in Woodmere Cemetery should maintain the current overstory; new trees should be planted as older ones are removed. At least part of the shoreline of the small pond in the area could be planted with shrubs or be allowed to revert to a more natural state; this latter action would encourage further pheasant and duck nesting. It is also possible to encourage nesting by birds such as purple martins and bluebirds by establishing nest boxes. It would, however, require considerable effort on the part of the maintenance staff to ensure that house sparrows and starlings did not take over the nest sites. Feeding is carried out within Woodmere Cemetery, and it should be continued.

An important aspect of managing any urban cemetery should be to encourage its use by residents of the immediate area. Bird watching, especially during the spring, was quite fruitful in this area, and the non-consumptive use of any wildlife produced here would be the justification for any habitat manipulation and/or feeding programs.

Ford Subsection

The Ford park subsection was one of two semi-natural areas examined during the present study. Bird populations were intermediate (Table 6), and the bird species diversity index was the second highest in 1972 and third highest in 1973 (Table 2). Management of this area should involve maintaining it in its present state. If this is done, the current bird population should remain fairly stable. Several specific projects could be undertaken to improve the area. First, the heavy trampling of the understory by children should be curtailed; this should improve conditions for birds of this stratum. Secondly, nature trails should be created, probably from existing trails, which would provide bird watchers with access to the different parts of the woodlot. Finally, cutting should be limited to only those trees which might present a hazard to hikers.

Golfview Subsection

The Golfview park subsection had both a very low bird species diversity and total population level (Tables 2 and 6). This subsection is the one area which could benefit most from management practices; it is also the area where such practices would be most feasible. The area is under private ownership and is entirely fenced. It also borders the Rouge River Park System, so that any habitat created would readily attract birds from this area. Management of the golf course should seek to create songbird habitat between the existing fairways. The addition of patches of herbaceous and woody growth beneath the groves of American elm and the planting of wooded stretches along the fairways should act not only to establish habitat for songbirds, but also to make the golf course more challenging and more aesthetically pleasing.

Dearborn Subsection

The Dearborn park subsection had the highest bird species diversity during both years of study of any of the five park areas (Table 2). The total bird population of the area was the second highest during both 1972 and 1973 (Table 6). Management in the Dearborn park should follow the same format as that for the Ford park subsection. Since this area is one of the few remaining semi-natural areas within metropolitan Detroit, and since nearly ideal bird habitat already exists there, the area should be maintained as it is. Nature trails may be desirable, but they should be limited in number so that the park can retain its natural qualities.

It is important that future research on the avifauna of urban parks attempts to establish definitive relationships between habitat variables and bird species diversity and the population levels of certain species. The techniques utilized in the present study should be adequate, except that data-gathering methods should be uniform and parklands chosen for study should be, within themselves, as uniform as possible.

Because urban parks often have very unique functions (e.g., golf course, cemetery), management for avifauna may not always be a top priority. Future research should seek to establish the role of birds and other wildlife in urban parks. Research should also attempt to determine the extent to which people could utilize this wildlife resource; ways in which human-wildlife interactions can best be maximized should also be studied.

Although this study was undertaken in order to determine the relationship of urban parks to the surrounding areas with respect to birdlife, it was not designed to gather quantitative data. Further studies should attempt to gather this information, since it will be vital to future ecologically-oriented subdivision design.

Although a detailed discussion of the development of an urban or regional plan for the management of birds (or all wildlife) is beyond the scope of the present study, it represents a field in which further research is needed. This study does, however, suggest certain steps which might be followed in the development of such a plan. A preliminary step in managing the avifauna of any region is to conduct an inventory of the resources in that region. The techniques developed in the present study should be adequate for such a procedure, although they do not represent the only methodology which could be employed. In order to conduct this inventory, the city must first be divided into distinct urban types based on the social, economic, and age characteristics of each neighborhood.

A second step in the development of a city-wide management program is to determine the value placed on birdlife by the various groups of individuals living in each of the urban types. A questionnaire such as that utilized in this study would be adequate for making such an evaluation.

After the results of both the inventory and questionnaire have been gathered and analyzed, management plans may be developed. It should be noted that much more research has to be conducted before such broadly-based management plans could be effective.

Finally, the extent to which those management steps cited above could be implemented is determined by policy decisions which act to set the overall goals of avifauna (wildlife) management in urban areas. This is in itself an area in which extensive research is needed. For example, a study to determine who has the responsibility of setting policy must be undertaken. Finally, as has been noted by Caldwell (1974), ". . . policies for wildlife must be tied to other policies, for example, to population, land-use, transportation, recreation, public safety, and economic growth, if they are to be viable."

SUMMARY

1. The results of this study show that although bird species diversity within the residential study areas increased as one moved from the center of the city to the suburbs, the total bird population of each residential subsection remained fairly constant.
2. Between 50 and 60 percent of the variance in bird species diversity and the population estimates for the cardinal and mounring dove in 1972 was accounted for by the habitat variables measured during this study.
3. The volume of buildings was shown to be significantly related to each of the eight dependent variables during both 1972 and 1973, while in 1972 the volume of all deciduous vegetation was shown to be related to all but two dependent variables.
4. This study has shown that there is an interaction of birds between parks and the residential areas that surround them. The type and extent of this interaction seems to depend upon the type of park and residential area involved.
5. It was determined that the transect method of bird censusing is best suited to urban studies.
6. The questionnaire revealed that most residents of each study area liked birds and watched them often. The cardinal, blue jay, and robin were highly regarded by residents of each area, even though these species were not always present in large numbers.
7. The results of this project are particularly applicable to new subdivision design, since major changes in the environment are

needed to effect changes in bird species diversity and bird population levels.

8. Management of park areas and urban open spaces must take into account the primary purpose for which they were developed; nonetheless, management for songbirds is desirable.

9. Areas of future research are discussed and include more detailed studies of the structure of both vegetation and buildings. Research must also be conducted to establish a unified wildlife policy which can be integrated into the urban planning process.

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APPENDICES

APPENDIX A. VEGETATIVE RESULTS

Vegetative parameters which were measured but not used in the regression analysis (see Analysis of the Interrelationship between Residential Habitat and Birdlife) include detailed data on each stratum within the residential and park subsections of each study area. The parameters listed in Tables 1 through 10 are density and dominance per acre of all vegetation, density and dominance per acre by species, and the average leaf and ground density class by species. Volumes were computed for individual species, but this data is not included in Tables 1 through 10 because it is virtually impossible to comprehend, thereby making it useless in describing the subsections.

Table 1. Vegetative parameters of the residential subsection of the Clark study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Maple, Silver	3.20	7.72	1.60	
Cherry spp.	1.92	.60	1.67	
Pear	1.28	.17	2.50	
Elm, American	1.92	4.56	2.00	
Elder, Box	1.28	.35	1.50	
Apple	.64	.17	3.00	
Locust, Black	.64	.03	2.00	
Pine, Austrian	.64	.22	2.00	
Maple, Norway	.64	.22	1.00	
Peach	.64	.09	3.00	
	12.78	14.16	1.90	
Shrub layer				
Arbor Vitae	8.31		1.08	2.85
Rose-of-Sharon	3.83		1.83	2.83
Rose spp.	24.28		2.00	2.57
Lilac spp.	8.94		1.43	2.07
Ninebark spp.	4.48		1.50	2.00
Forsythia spp.	5.75		1.33	2.11
Mock-orange spp.	2.56		1.50	1.75
Barberry spp.	1.92		2.00	3.00
Yew spp.	2.56		1.50	2.75
Privet spp.	27.48		1.28	2.44
Juniper spp.	4.48		1.00	2.57
Honeysuckle spp.	.64		1.00	2.00
Currant spp.	2.56		2.50	2.50
Spruce, Blue	.64		1.00	2.00
Spruce, White	1.28		1.00	1.50
Elm, American	1.28		1.50	2.50
Maple, Silver	.64		2.00	3.00
Ailanthus	4.48		2.33	2.83
Mulberry spp.	.64		1.00	1.00
Elder, Box	.64		1.00	1.00
	107.35		1.55	2.44

*See Appendix F for scientific names.

Table 2. Vegetative parameters of the park subsection of the Clark study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
<u>Overstory</u>				
Elm, American	3.24	5.69	2.00	
Ailanthus	.12	.20	3.00	
Oak, Swamp White	.35	.61	2.00	
Oak, Black	.46	.81	2.00	
Oak, White	.93	1.62	2.00	
Oak, Bur	.35	.61	1.00	
Oak, Red	.58	1.02	2.00	
Oak, Pin	.12	.20	2.00	
Maple, Sugar	1.51	2.64	2.50	
Maple, Norway	3.24	5.69	1.75	
Maple, Silver	.35	.61	2.00	
Hickory, Pignut	.23	.41	1.00	
Coffee-tree, Kentucky	.12	.20	3.00	
Cottonwood	.23	.41	2.00	
Horse-chestnut	.12	.20	1.00	
Apple	.46	.81	2.00	
Sycamore	1.51	2.64	4.00	
Ash, White	1.97	3.45	1.67	
Ash, Black	.46	.81	2.00	
	16.34	28.63	2.11	
<u>Shrub layer</u>				
Honeysuckle spp.	.71		1.00	2.50
Barberry spp.	.09		1.00	2.00
Euonymus, Winged	.19		1.00	2.00
Ninebark spp.	.46		1.80	1.40
Viburnum spp.	.09		1.00	1.00
Maple spp.	.09		2.00	2.00
			1.25	2.05

*See Appendix F for scientific names.

Table 3. Vegetative parameters of the residential subsection of the Woodmere study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Maple, Silver	4.33	14.20	1.80	
Maple, Norway	.87	.38	1.00	
Mountain-ash	.87	.57	3.00	
Locust, Black	1.73	5.69	3.00	
Elm, American	1.73	6.20	2.00	
Ailanthus	1.73	2.19	2.00	
Mulberry spp.	.87	.08	2.00	
Apple	1.73	2.35	2.00	
	13.84	31.65	2.06	
Shrub layer				
Barberry spp.	7.79		1.33	1.89
Privet spp.	5.19		2.00	3.00
Rose spp.	25.95		2.68	2.82
Yew spp.	3.46		1.00	3.00
Mock-orange spp.	.86		2.00	3.00
Lilac spp.	6.05		2.00	2.57
Spirea spp.	1.73		1.00	3.00
Arbor Vitae	6.05		1.00	2.43
Forsythia spp.	1.73		1.00	2.50
Juniper spp.	1.73		1.00	2.50
Yew spp.	2.59		2.00	3.00
Currant spp.	.86		2.00	2.00
Spruce, Blue	3.46		1.75	2.25
Mimosa	.86		3.00	3.00
Mulberry spp.	.86		2.00	2.00
Maple, Silver	.86		3.00	3.00
	70.07		1.98	2.67

*See Appendix F for scientific names.

Table 4. Vegetative parameters of the park subsection of the Woodmere study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Maple, Silver	1.70	3.74	2.25	
Maple, Norway	4.24	9.34	1.78	
Maple, Sugar	.09	.21	2.00	
Maple, Red	.38	.83	2.00	
Oak, White	1.32	2.91	2.29	
Oak, Bur	.66	1.45	2.00	
Oak, Red	1.13	2.49	2.25	
Oak, Pin	.28	.62	2.00	
Horse-chestnut	.75	1.66	3.00	
Ginkgo	.38	.83	2.00	
Butternut	.28	.62	2.25	
Tulip-tree	.47	1.04	2.00	
Basswood	.38	.83	1.33	
Apple	.09	.21	2.00	
Spruce, Blue	.19	.42	1.00	
Willow	.09	.21	2.00	
Birch, Yellow	.09	.21	3.00	
Gum, Sweet	.09	.21	1.00	
Magnolia, Cucumber	.09	.21	2.00	
Locust, Black	.09	.21	2.00	
	12.82	28.23	2.05	
Shrub layer				
Barberry spp.	.57		1.00	2.00
Yew spp.	3.96		1.00	1.50
Rose spp.	.19		3.00	3.00
Willow spp.	.57		1.00	1.00
Honeysuckle spp.	.09		1.50	2.50
Juniper spp.	.09		1.00	1.50
Mulberry spp.	2.83		2.00	2.00
Dogwood, Flowering	.19		2.00	3.00
Arbor Vitae	.09		1.00	2.50
	6.03		1.15	1.65

*See Appendix F for scientific names.

Table 5. Vegetative parameters of the residential subsection of the Ford study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Mulberry spp.	1.00	.47	2.00	
Apple	1.50	.62	1.00	
Cherry spp.	2.00	.41	1.75	
Elm, American	5.00	8.97	2.13	
Spruce, Blue	1.00	.09	1.00	
Dogwood, Flowering	.50	.04	2.00	
Ash, White	.50	.98	2.00	
Maple, Silver	4.00	7.11	1.75	
Plum spp.	1.50	.32	2.33	
Maple, Norway	3.49	.99	1.57	
Crabapple spp.	.50	.15	2.00	
Maple, Sugar	.50	.22	2.00	
Oak, Pin	.50	.22	2.00	
Locust, Honey	.50	.002	1.00	
Sycamore	.50	.79	2.00	
Oak, Red	.50	.39	2.00	
	23.47	21.76	1.79	
Shrub layer				
Yew spp.	35.94		1.13	1.42
Juniper spp.	12.98		1.35	1.70
Arbor Vitae	8.49		1.18	2.71
Dogwood spp.	3.00		1.50	2.00
Forsythia spp.	3.00		1.33	2.33
Lilac spp.	7.49		2.20	2.87
Mock-orange spp.	5.49		1.55	1.27
Grape spp.	.49		2.00	3.00
Rose spp.	6.99		3.00	3.00
Boxwood	.49		2.00	2.00
Mugho Pine	1.49		2.00	1.00
Euonymus spp.	2.00		1.25	1.75
Maple spp.	1.00		3.00	3.00
Viburnum spp.	2.00		2.00	2.00
Holly-grape, Oregon	.49		2.00	2.00
Quince spp.	.49		1.00	3.00
Barberry spp.	7.49		1.00	1.93
Ailanthus	.49		3.00	3.00
Honeysuckle	1.00		1.50	2.50
Spruce, Blue	5.49		1.00	1.00
Rose-of-Sharon	1.49		1.67	2.67
Elm, American	1.00		2.00	3.00

Table 5 (cont'd).

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Cherry spp.	1.00		2.00	3.00
Magnolia spp.	.49		2.00	3.00
Privet spp.	3.49		1.00	1.50
Rhododendron spp.	.49		1.00	2.00
Unknown	.49		1.00	2.00
	114.83		1.44	1.89

*See Appendix F for scientific names.

Table 6. Vegetative parameters of the park subsection of the Ford study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Oak, Pin	6.50	16.07	2.40	
Maple, Silver	3.90	9.64	2.00	
Oak, Red	18.19	45.00	2.00	
Hickory, Pignut	1.30	3.21	2.00	
Oak, Swamp White	3.90	9.64	1.67	
Cottonwood	1.30	3.21	3.00	
Maple, Silver	9.10	22.49	2.86	
Sycamore	2.60	6.43	2.50	
Tulip-tree	2.60	6.43	2.00	
Oak, Black	1.30	3.21	2.00	
Oak, White	2.60	6.43	2.00	
Maple, Red	5.20	12.85	1.50	
Sassafras	1.30	3.21	1.00	
Gum, Black	1.20	3.21	2.00	
Oak, Bur	1.20	3.21	2.00	
	62.36	154.26	2.13	
Intermediate layer				
Maple, Sugar	13.52	1.34	2.40	
Sassafras	13.52	1.34	2.20	
Ash, White	10.81	1.07	3.00	
Maple, Silver	5.41	.54	2.00	
Hickory, Pignut	2.70	.27	2.00	
Hornbeam, Hop	10.81	1.07	2.50	
Hawthorn spp.	8.11	.80	2.67	
Witch-hazel	5.41	.54	2.50	
Tulip-tree	2.70	.27	2.00	
Beech, Blue	16.22	1.60	2.17	
Maple, Red	27.03	2.67	2.40	
Beech	10.81	1.07	2.25	
Gum, Black	2.70	.27	2.00	
	129.75	12.82	2.38	
Shrub layer				
Unknown	18.01		3.00	2.00
Dogwood, Red-osier	18.01		3.00	3.00
Cherry, Choke	72.11		2.25	2.75
Spicebush	432.81		2.25	2.71
Sassafras	36.10		3.00	3.00
Grape	18.01		1.00	1.00

Table 6 (cont'd).

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Witch-hazel	54.10		2.00	2.67
Elderberry, Common	54.10		3.00	3.00
Ash, White	72.11		2.75	3.00
Ash, Red	54.10		3.00	3.00
Maple, Silver	36.10		2.50	2.50
	865.63		2.42	2.73

*See Appendix F for scientific names.

Table 7. Vegetative parameters of the residential subsection of the Golfview study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Spruce, Norway	2.74	1.26	1.50	
Spruce, Blue	2.74	.66	1.00	
Spruce, White	.91	.003	1.00	
Cherry spp.	.91	.69	2.00	
Crabapple spp.	1.83	1.14	1.50	
Ash, White	.46	.06	2.00	
Maple, Norway	5.93	2.24	1.46	
Maple, Silver	3.19	3.17	2.00	
Maple, Red	1.83	1.22	1.75	
Mulberry spp.	1.37	.12	1.80	
Elm, American	8.67	16.25	1.90	
Tulip-tree	.46	.30	1.00	
Oak, Pin	1.83	3.26	2.00	
Oak, Red	.46	1.32	2.00	
Plum	1.37	.49	1.33	
Magnolia	.91	.90	2.00	
Gum, Sweet	.46	.12	2.00	
Fir, Douglas	.91	.05	1.00	
Cedar, White	.46	.04	1.00	
Locust, Honey	.46	.04	2.00	
Locust, Black	.46	.49	3.00	
Dogwood, Flowering	.91	.08	2.00	
Walnut	.91	.84	2.00	
Birch, Paper	.91	.36	2.50	
Basswood	.46	.17	2.00	
	41.52	34.45	1.70	
Shrub layer				
Yew spp.	78.47		1.08	1.55
Juniper spp.	25.99		1.19	1.11
Arbor Vitae	51.10		1.23	2.33
Mock-orange spp.	11.00		1.78	2.61
Honeysuckle spp.	25.99		1.38	2.25
Lilac spp.	10.50		2.24	2.34
Barberry spp.	14.62		1.00	2.07
Rose-of-Sharon	3.66		2.50	3.00
Forsythia spp.	6.83		1.06	1.44
Maple, Norway	30.57		2.00	3.00
Beautybush	78.47		1.00	3.00
Mulberry	25.99		2.00	3.00
Buckthorn spp.	51.10		2.00	3.00

Table 7 (cont'd).

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Rose spp.	11.00		3.00	3.00
Elm, American	25.99		1.00	3.00
Grape spp.	10.50		1.00	3.00
Euonymus, Winged	14.62		2.11	2.67
Willow spp.	.46		3.00	3.00
Cherry, Manchu	.92		1.50	2.50
Walnut	.46		3.00	3.00
Peach	.46		3.00	3.00
Locust spp.	.46		3.00	3.00
Crabapple spp.	.92		2.00	3.00
Ninebark spp.	.92		3.00	3.00
Dogwood, Flowering	1.37		2.67	3.00
Dogwood spp.	2.29		2.72	2.70
Azalea spp.	3.21		2.50	2.50
Rhododendron spp.	5.46		2.18	2.27
Plum	.46		2.00	3.00
Maple, Japanese	.46		1.00	2.00
Contoneaster	4.12		1.00	1.00
Viburnum	1.37		2.00	2.67
Privet spp.	1.37		1.67	2.00
Alder, Black	.46		2.00	3.00
Willow, Pussy	.46		2.00	3.00
Pieris japonica	.46		2.00	3.00
Spruce, Blue	3.21		1.00	1.14
Boxwood	.92		1.00	2.00
Holly-grape, Oregon	.92		2.00	2.00
Olive, Russian	.46		2.00	3.00
Unknown	2.75		1.00	1.00
Ash spp.	.46		3.00	3.00
Spiraea spp.	.92		2.00	3.00
Barberry spp.	.46		2.00	3.00
Maple spp.	.46		1.00	3.00
Euonymus vegetus	.92		2.00	3.00
	352.19		1.52	2.19

*See Appendix F for scientific names.

Table 8. Vegetative parameters of the park subsection of the Golfview study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Elm, American	8.45	7.69	2.01	
Hickory, Shagbark	.07	.11	2.00	
Oak, White	.07	.20	1.00	
Oak, Bur	.07	.37	2.00	
Maple, Silver	.21	.48	2.33	
Ash, White	1.12	.36	2.06	
Oak, Swamp White	.07	.02	2.00	
	10.06	9.23	2.02	
Intermediate layer				
Pine, Scotch	.14	.01	2.00	
Pine, Red	.49	.04	2.00	
Hawthorn spp.	33.80	20.41	2.00	
Cherry spp.	.35	.21	2.00	
Maple, Silver	1.54	.16	2.00	
Oak, Pin	1.26	.15	2.00	
Oak, White	.07	.01	2.00	
Maple, Red	.56	.03	2.00	
Birch, Paper	.07	.01	1.00	
Oak, Red	.07	.003	2.00	
Sumac, Staghorn	.42	.002	2.00	
Dogwood spp.	.63	.003	2.00	
	39.40	21.04	1.99	
Shrub layer				
Dogwood spp.	301.66**		1.08	2.00
Ash, White	5.03**		3.00	3.00
	306.69**		1.11	2.02

* See Appendix F for scientific names.

**This data reflects the combination of the raw data for the golf course and shrubby area. There were only four hawthorn and no dogwood or ash on the golf course itself.

Table 9. **Vegetative parameters of the residential subsection of the Dearborn study area.**

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Maple, Norway	1.35	.33	1.00	
Maple, Sugar	1.81	1.65	1.67	
Maple, Silver	.45	.02	3.00	
Locust, Black	2.71	.43	2.33	
Locust, Honey	90	.12	2.50	
Oak, Red	1.81	2.58	2.00	
Oak, Pin	.45	.09	2.00	
Pine, Red	3.16	.28	1.00	
Pine, White	2.26	.11	1.40	
Hemlock	4.97	.35	1.00	
Spruce, Blue	9.49	.41	1.00	
Fir, Douglas	.45	.04	1.00	
Olive, Russian	1.81	.25	1.75	
Redbud	1.35	.04	1.67	
Birch	3.62	.56	1.75	
Plum	1.81	.12	1.75	
Cherry spp.	.62	.10	2.00	
Hackberry	1.35	.37	2.00	
Butternut	.45	.48	2.00	
Walnut	.45	.48	2.00	
Ash, White	.90	.30	2.00	
Elm, American	2.71	2.72	2.00	
Crabapple spp.	1.81	.20	1.75	
Hawthorn spp.	3.16	2.53	1.29	
Wisteria	.45	.003	1.00	
Elder, Box	.45	.09	2.00	
Basswood	.45	.12	1.00	
Sycamore	.45	.01	2.00	
Magnolia spp.	.45	.03	1.00	
Unknown	.45	.10	2.00	
	52.87	14.84	1.51	
Shrub layer				
Juniper spp.	74.10		1.00	1.10
Yew spp.	72.02		1.00	1.03
Euonymus spp.	20.79		1.61	2.07
Forsythia spp.	9.04		1.09	2.36
Ninebark spp.	10.86		1.17	2.04
Rhododendron spp.	2.26		1.40	2.40
Azalea spp.	19.89		1.48	1.75
Arbor Vitae	9.50		1.00	1.57

Table 9 (cont'd).

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Witch-hazel	1.36		2.00	3.00
Dogwood, Flowering	.46		2.00	3.00
Contoneaster spp.	9.04		1.65	1.65
Smokebush	.90		1.50	2.50
Mock-orange spp.	2.26		1.50	2.00
Honeysuckle spp.	1.80		1.00	2.00
Privet spp.	12.19		2.33	2.73
Mugho Pine	1.80		1.00	1.00
Rose spp.	7.67		3.00	2.87
Holly-grape, Oregon	.90		2.00	2.00
Barberry spp.	3.62		1.13	2.00
Magnolia spp.	.46		2.00	3.00
Viburnum spp.	1.36		1.00	2.00
Maple, Japanese	.46		2.00	3.00
Raspberry spp.	.46		2.00	2.00
Lilac	3.62		2.25	3.00
Maple, Silver	.46		3.00	3.00
Rose-of-Sharon	.46		2.00	3.00
Unknown	.46		3.00	3.00
Unknown	.90		2.00	3.00
Unknown	.46		2.00	3.00
	256.67		1.30	1.58

*See Appendix F for scientific names.

Table 10. Vegetative parameters of the park subsection of the Dearborn study area.

Species*	Density per acre	Dominance-basal area per acre	Average leaf density class	Average ground density class
Overstory				
Elder, Box	80	28.49	2.01	
Hawthorn spp.	34	9.65	2.15	
Buckthorn spp.	4	1.24	1.00	
Walnut, Black	4	1.24	2.00	
Ash, Black	18	23.74	2.20	
	140	64.36	2.06	
Shrub layer				
Elder, Box	24		2.61	2.69
Cherry, Black	2		2.00	3.00
Ash, Black	22		2.00	3.00
Elderberry, Common	8		2.00	3.00
Dogwood, Gray	14		1.00	2.00
	70		1.90	2.70

*See Appendix F for scientific names.

APPENDIX B. QUESTIONNAIRE

Figure 1. Letter of Introduction.

Dear Sir:

Many people are making guesses about the way people feel toward birds and other animals in the city - but we would like to find out by asking them directly. We are presently conducting a study at Michigan State University to determine which animals can be found in the Detroit area, some of their interrelationships, and the attitudes of people toward them.

A student from the Department of Fisheries and Wildlife at Michigan State University will contact you within the next few weeks. We would like to ask you to take 20 minutes of your time to answer a few questions about your attitudes toward the animals you see in your neighborhood and yard. We will also use photographs of 20 selected animals in order to determine which ones you enjoy seeing most. We are planning to contact about 25 percent of the households in your immediate neighborhood; the information will be statistically combined to give a total picture. Any information relating to you as an individual will be held in strictest confidence, and all data gathered will be limited solely to the present study.

Thank you for your interest.

Sincerely,

James R. Schinner

Darrell L. Cauley

Wayne Schmidt

Graduate Assistants
Department of Fisheries & Wildlife
Michigan State University

Figure 2. Questionnaire.

Background Questions

1. What is your occupation?
2. Do you participate in outdoor activities such as hunting, fishing, camping, etc?
3. Do you garden?
4. Do you use pesticides on your lawn or garden?
5. Do you have a cat that runs loose at least part of the time?
6. Do you have a dog?
7. How many adults (16 years and older) are living at your residence?
8. How many children (15 years and younger) are living at your residence?

Questions on Attitude

1. Do you feed the birds in your yard on a regular basis during some season of the year?
2. Do you provide water for songbirds such as a birdbath or garden pool?
3. A. Do you seek to attract birds to your yard by providing nest boxes?
   B. How many nest boxes do you have?
4. A. Do you ever watch the birds in your yard?
   B. If so, how often? Often Occasionally Rarely
5. A. Do birds use any part of your house or garage for nesting or roosting (resting, sleeping)?
   B. If so, where do they nest?
   C. Where do they roost?
6. A. Do birds nest in other areas of your yard?
   B. If so, where?
7. Which birds do you enjoy seeing most?
8. Which birds do you least enjoy?
9. A. Do you actively discourage birds on your property?
   B. If so, how?
   C. Which ones do you discourage?
10. Do you generally like, dislike, or are you indifferent to the birds in your yard?

APPENDIX C. BIRD HEIGHT AND LOCATION

During the two years of this study, the height and location of every bird observed was recorded. Heights were estimated to the nearest foot below ten feet and to the nearest five feet above ten feet. This information is presented in Tables 1 through 10 and is grouped into five strata (ground, 0 to 3 feet, 4 to 12 feet, 13 to 30 feet, and greater than 30 feet). The location in which each bird was seen is also presented in Tables 1 through 10. Location categories were divided into two types, vegetative and non-vegetative. In the residential subsections non-vegetative types were further subdivided into buildings, wire, and fence, and in the park subsections special categories (e.g., park benches and grave markers) were used. Finally, two additional categories are provided in Tables 1 through 10 for those birds which were either seen in flight or heard but not seen.

Table 1. Bird height and location data for the seven selected species in the Clark residential subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Fence	Heard
Starling	18.13*					41.45	19.17	9.84	9.33	1.55	.52
(193)**	18.13		5.18	32.12	2.59	41.45					.52
House Sparrow	17.29					40.98	10.15	4.51	13.91	1.88	11.28
(266)	17.29		10.53	19.92		40.98					11.28
Robin	19.23					32.69	23.08	9.62	9.62	1.92	3.85
(52)	19.23		7.69	32.69	3.85	32.69					3.85
Grackle	30.00					20.00	40.00		3.33	6.67	
(30)	30.00		6.67	40.00	3.33	20.00					
Blue Jay						80.00		20.00			
(5)				20.00		80.00					
Cardinal						50.00					50.00
(2)						50.00					50.00
Mourning Dove	50.00					25.00	25.00				
(4)	50.00				25.00	25.00					

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 2. **Bird height and location data for the seven selected species in the** Woodmere residential **subsection.**

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Fence	Heard
Starling	6.92*					67.69	12.31	6.92	4.62		1.54
(130)**	6.92		2.31	21.54		67.69					1.54
House Sparrow	8.31					54.15	6.64	3.65	16.28		10.62
(301)	8.31		6.31	18.94	1.66	54.15					10.62
Robin	20.78					31.17	22.08	3.90	15.58	3.90	2.60
(77)	20.78		6.49	31.17	7.79	31.17					2.60
Grackle	8.14					50.00	18.60	15.12	8.14		
(86)	8.14			38.37	3.49	50.00					
Blue Jay						76.74	13.95		2.33		6.98
(43)			2.33	6.98	6.98	76.74					6.98
Cardinal											
(0)											
Mourning Dove						66.67		16.67	16.67		
(12)				33.33		66.67					

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 3. Bird height and location data for the seven selected species in the Ford residential subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Fence	Heard
Starling	25.77*					46.63	12.27	7.98	5.52		1.84
(163)**	25.77		1.84	22.70	1.23	46.63					1.84
House Sparrow	6.22					42.22	12.89	4.89	19.11	1.33	13.33
(225)	6.22	.89	8.44	28.89		42.22					13.33
Robin	37.06					30.59	14.71	4.12	8.24	1.18	4.12
(170)	37.06		2.35	23.53	2.35	30.59					4.12
Grackle	6.42					60.55	19.27	6.42	6.42		.92
(109)	6.42		5.50	26.61		60.55					.92
Blue Jay	3.51					58.77	21.93	5.26	2.63		7.89
(114)	3.51		4.39	20.18	5.26	58.77					7.89
Cardinal	8.00					36.00	16.00	4.00			36.00
(25)	8.00			20.00		36.00					36.00
Mourning Dove	4.12					44.33	6.19	32.99	8.25		4.12
(97)	4.12		2.06	42.27	3.09	44.33					4.12

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 4. Bird height and location data for the seven selected species in the Golfview residential subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vegetative Cover	Wire	Building	Nest Box	Fence	Heard
Starling	29.33*					30.00	25.33	4.00	8.67	1.33		2.67
(150)**	29.33	.67	3.33	32.67	2.67	30.00						2.67
House Sparrow	9.63					40.64	21.39	2.14	8.56	1.60	.53	17.11
(187)	9.63		13.37	19.25	1.60	40.64						17.11
Robin	46.33					21.47	18.08	2.26	9.04			2.82
(177)	46.33		8.47	18.64	2.26	21.47						2.82
Grackle	28.99					38.46	23.67	5.92	2.37			.59
(169)	28.99		1.18	27.22	3.55	38.46						.59
Blue Jay	14.86					44.59	22.97	5.41	5.41			6.76
(74)	14.86		8.11	21.62	4.05	44.59						6.76
Cardinal	3.39					35.59	25.42	3.39	5.08			27.12
(59)	3.39		6.78	23.73	3.39	35.59						27.12
Mourning Dove	30.26					32.89	3.95	23.68	3.95			5.26
(76)	30.26			30.26	1.32	32.89						5.26

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 5. Bird height and location data for the seven selected species in the Dearborn residential subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vegetative Cover	Wire	Building	Feeder	Fence	Heard
Starling	20.00*					75.00						5.00
(20)**	20.00					75.00						5.00
House Sparrow	17.27					28.18	10.91		14.09	18.64		10.91
(220)	17.27		28.64	14.09	.91	28.18						10.91
Robin	36.59					24.39	29.27		4.88			4.88
(41)	36.59		14.63	14.63	4.88	24.39						4.88
Grackle	15.94					49.28	15.94		1.45	11.59		5.80
(69)	15.94		13.04	8.70	7.25	49.28						5.80
Blue Jay						66.67	16.67			5.56		11.11
(18)			11.11	5.56	5.56	66.67						11.11
Cardinal	7.69					23.08	38.46					30.77
(13)	7.69		30.77	7.69		23.08						30.77
Mourning Dove	29.41					41.18	17.65		2.94	5.88		2.94
(34)	29.41		5.88	20.59		41.18						2.94

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 6. Bird height and location data for the seven selected species in the Clark Park subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Bench	Fence	Heard
Starling	65.94*					22.46	10.14					1.45
(138)**	65.94			10.14		22.46						1.45
House Sparrow	68.78					16.93	10.05		1.06			3.17
(189)	68.78		3.17	7.94		16.93						3.17
Robin	58.62					17.24	17.24					6.90
(29)	58.62			17.24		17.24						6.90
Grackle	90.43					6.96	2.61					
(115)	90.43			2.61		6.96						
Blue Jay	33.33						50.00			16.67		
(6)	33.33	16.67		16.67	33.33							
Cardinal												
(0)												
Mourning Dove	33.33					16.67	16.67					33.33
(6)	33.33				16.67	16.67						33.33

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 7. **Bird height and location data for the seven selected species** in the Woodmere park subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vegetative Cover	Wire	Building	Fence	Grave Marker	Heard
Starling	27.83*					49.57	18.26				1.74	2.61
(115)**	27.83	.87	.87	10.43	7.83	49.57						2.61
House Sparrow	32.43					54.05	5.41			2.70	5.41	
(37)	32.43	5.41	2.70	5.41		54.05						
Robin	29.23					26.15	30.77				9.23	4.62
(65)	29.23	1.54	10.77	23.08	4.62	26.15						4.62
Grackle	32.05					50.00	16.67				1.28	
(78)	32.05	1.28		14.10	2.56	50.00						
Blue Jay						34.38	31.25				15.63	18.75
(32)		9.38	6.25	21.88	9.38	34.38						18.75
Cardinal												
(0)												
Mourning Dove	14.29					57.14	21.43					7.14
(28)	14.29			14.29	7.14	57.14						7.14

* **Figures represent the percentage of birds in each category.**

** **Total number of birds seen.**

Table 8. **Bird height and location data for the seven selected species in the Ford park** subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Fence	Heard
Starling	.95*					40.95	55.24				
(105)**	.95			3.81	51.43	40.95					2.86
											2.86
House Sparrow	33.33					16.67	50.00				
(24)	33.33	16.67	4.17	4.17	25.00	16.67					
Robin	11.11					25.00	27.78				27.78
(36)	11.11		8.33	13.89	5.56	25.00					27.78
Grackle	1.67					55.00	36.67				6.67
(60)	1.67			16.67	20.00	55.00					6.67
Blue Jay						22.95	39.34				37.70
(61)				9.84	29.51	22.95					37.70
Cardinal						50.00					50.00
(2)						50.00					50.00
Mourning Dove	50.00					25.00	25.00				
(4)	50.00				25.00	25.00					

* **Figures represent the percentage of birds in each category.**

** **Total number of birds seen.**

Table 9. Bird height and location data for the seven selected species in the Golfview park subsection.

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vegetative Cover	Wire	Building	Fence	Heard
Starling	51.61*					41.94	6.45				
(31)**	51.61			3.23	3.23	41.94					
House Sparrow	22.22					44.44	5.56			27.78	
(18)	22.22	16.67	16.67			44.44					
Robin	55.56					26.98	14.29				3.17
(63)	55.56		1.59	11.11	1.59	26.98					3.17
Grackle	10.48					45.71	41.90				1.90
(105)	10.48		6.67	34.29	.95	45.71					1.90
Blue Jay	7.69					53.85	23.08				15.38
(13)	7.69			15.38	7.69	53.85					15.38
Cardinal	18.75					25.00	37.50				18.75
(16)	18.75	6.25	25.00	6.25		25.00					18.75
Mourning Dove	36.36					63.64					
(22)	36.36					63.64					

* Figures represent the percentage of birds in each category.

** Total number of birds seen.

Table 10. **Bird height and location data for the seven selected species in the Dearborn park subsection.**

Species	Ground	0-3'	4-12'	13-30'	>30'	Flying	Vege-tative Cover	Wire	Building	Fence	Heard
Starling	11.34*					35.05	45.36				8.25
(97)**	11.34			11.34	34.02	35.05					8.25
House Sparrow	4.17					41.67	41.67				12.50
(24)	4.17		8.33	12.50	20.83	41.67					12.50
Robin	7.27					38.18	32.73				21.82
(55)	7.27		5.45	18.18	9.09	38.18					21.82
Grackle	2.26					57.89	30.08				9.77
(133)	2.26	.75	1.50	18.05	9.77	57.89					9.77
Blue Jay						49.23	29.23				21.54
(65)		1.54	7.69	4.62	15.38	49.23					21.54
Cardinal	.78					16.28	25.58				57.36
(129)	.78		14.73	8.53	2.33	16.28					57.36
Mourning Dove	5.36					48.21	35.71				10.71
(56)	5.36		1.79	23.21	10.71	48.21					10.71

* **Figures represent the percentage of birds in each category.**

** **Total number of birds seen.**

APPENDIX D. NESTING DATA

During the two years of this study, information was gathered on 81 nests of 14 species of birds. Tables 1 through 5 give the species, subsection, height, location, and notes for each nest which was discovered. Because of a lack of time and the fact that the main emphasis of this study was not on breeding, dummy and second nests, as well as nesting success, were not noted. Specific nest searches were made for the robin, so the information presented for this species probably represents typical circumstances under which it nests in the city. Information is also fairly extensive for the house sparrow and starling.

Within the residential subsections of each study area, the average nesting height for robins was as follows: Clark, 28.5 feet; Woodmere, 25.8 feet; Ford, 22.8 feet; Golfview, 25.8 feet; Dearborn, 20.0 feet (Tables 1 through 5). Mehner (1958) reported the nesting height of the robin in his Pittsburgh and East Lansing study areas to be 14.5 feet and 20.3 feet, respectively. Thus, it would appear that in the present study robins are generally nesting at higher elevations. It is possible that disturbance was a factor in causing robins to select higher nest sites. Within the Ford and Dearborn residential subsections, birds nested at 22.8 feet and 20.0 feet, respectively; these are also the areas that had the smallest number of very large trees, with proportionally more trees in the lower to middle strata. Thus, robins in these two areas may have nested at higher elevations if there had been a greater number of taller trees present.

Robins were observed nesting in nine different species of trees in the five residential subsections. Ten nests were found in silver maple,

Table 1. Nesting data for the Clark study area.

Species	Subsection*	Height**	Location	Notes
Robin	R	25	Silver maple	
Robin	R	30	Sycamore	
Robin	R	30	Silver maple	
House Sparrow	R	35	Under roof	
House Sparrow	R	20	Under gutter	
House Sparrow	R	20	Crack by gutter	
Starling	R	8	Silver maple	Cavity nest
Brown Thrasher	R	8	Shrub spp.	Shrub isolated

* R indicates residential subsection; P indicates park subsection.

** Height in feet.

Table 2. Nesting data for the Woodmere study area.

Species	Subsection*	Height**	Location	Notes
Robin	R	19	Blue spruce	
Robin	R	35	Silver maple	
Robin	R	35	Norway maple	
Robin	R	30	Silver maple	
Robin	R	35	Silver maple	
Robin	R	25	Ailanthus	
Robin	R	25	Norway maple	
Robin	P	35	Norway maple	
Robin	P	15	Basswood	At extreme end of limb
House Sparrow	R	30	Black locust	
House Sparrow	R	22	Under roof	
House Sparrow	R	25	Eave	
House Sparrow	R	30	Chimney	
House Sparrow	R	18	Under gutter	
Starling	R	25	Attic	Entrance through window
Pigeon	R	25	Attic	Reported by resident

* R indicates residential subsection; P indicates park subsection.

** Height in feet.

Table 3. Nesting data for the Ford study area.

Species	Subsection*	Height**	Location	Notes
Robin	R	20	Silver maple	
Robin	R	25	American elm	
Robin	R	20	American elm	
Robin	R	20	Norway maple	
Robin	R	25	Norway maple	
Robin	R	30	Box elder	
Robin	R	30	Silver maple	
Robin	R	20	Norway maple	
Robin	R	15	Silver maple	
Robin	P	25	Red oak	
House Sparrow	R	12	Blue spruce	
House Sparrow	R	8	Silver maple	
House Sparrow	R	15	Blue spruce	
House Sparrow	R	10	Vines on house	
Starling	R	10	Nest box	
Starling	R	15	Silver maple	Cavity nest
Starling	R	15	American elm	Cavity nest
Starling	R	45	Silver maple	Cavity nest
Starling	P	35	Dead tree	Cavity nest
Starling	P	40	Dead tree	Cavity nest
Starling	P	40	Beech	Cavity nest
Grackle	R	25	Tree spp.	
Mourning Dove	R	30	Silver maple	

Table 3 (cont'd).

Species	Subsection	Height	Location	Notes
Cardinal	R	5	Shrub spp.	
Blue Jay	P	15	White oak	
Wood Duck	P	45	Tulip-poplar	Cavity nest

* R indicates residential subsection; P indicates park subsection.

** Height in feet.

Table 4. Nesting data for the Golfview study area.

Species	Subsection*	Height**	Location	Notes
Robin	R	9	Silver maple	
Robin	R	25	American elm	
Robin	R	25	White oak	
Robin	R	35	Swamp white oak	Nest 20 feet from trunk
Robin	R	35	Silver maple	
Robin	P	25	American elm	
House Sparrow	R	15	Blue spruce	
House Sparrow	R	15	Blue spruce	
House Sparrow	R	10	Nest box	
House Sparrow	R	25	Attic	
House Sparrow	R	10	Nest box	
Starling	R	13	In stove vent	Bird learned to open vent to gain access
Starling	R	10	Nest box	
Mallard	P	0	Ground	Within ten feet of road construction
Baltimore Oriole	P	25	American elm	
Red-winged Blackbird	P	10	Hawthorn	
Red-winged Blackbird	P	15	Hawthorn	
Red-winged Blackbird	P	12	Hawthorn	
Red-winged Blackbird	P	13	Hawthorn	

Table 4 (cont'd).

Species	Subsection	Height	Location	Notes
Red-winged Blackbird	P	12	Hawthorn	

* R indicates residential subsection; P indicates park subsection.

** Height in feet.

Table 5. Nesting data for the Dearborn study area.

Species	Subsection*	Height**	Location	Notes
Robin	R	20	American elm	
Robin	P	20	Hawthorn	
Robin	P	35	Sugar maple	
Starling	P	40	Sycamore	Cavity nest
Mourning Dove	R	30	White pine	
Mourning Dove	P	20	Box elder	
House Wren	P	4	Fence post	
House Wren	P	3	Hawthorn	
House Wren	P	4	Nest box	
Baltimore Oriole	P	40	Silver maple	
Baltimore Oriole	P	40	Black walnut	
Mallard	P	0	Ground	

* R indicates residential subsection; P indicates park subsection.

** Height in feet.

five in Norway maple, and three in American elm; each of the remaining tree species had only one nest (Tables 1 through 5). Although a detailed study of nesting micro-habitat was not made, it seems likely that some structural feature of the tree, rather than its actual species, was a more important factor in determining nesting occurrence. It is felt that the presence of several nests in the two species of maple and in the American elm reflects the relative abundance of these trees and not a preference for the species per se.

Fewer robin nests were discovered in the park subsection of each study area than were found in the residential subsections. The nesting heights ranged from 15 to 35 feet for the six nests located, with an average height of approximately 25 feet for each subsection (Tables 1 through 5). The Clark area was an exception, since no nests were found there. Within natural areas, Preston and Norris (1947) found robins nesting between two and 35 feet, with the average being 10.2 feet. In the park subsections, each robin nest was found in a different species of tree. Thus, the species involved did not appear to be as important as some structural aspect of the vegetation.

Sixteen house sparrow nests were located during routine bird censusing; ten of these nests were located either on buildings or in nest boxes, while the remaining nests were found in vegetation. Blue spruce was the tree which was most frequently used for nesting. Woolfenden and Rohwer (1969) have also noted that this species nests in ". . . human edifices or dense trees."

During the course of this investigation, several interesting examples of adaptation by nesting birds were observed. In 1972 within the Golfview residential subsection, a starling nest was discovered in a stove vent. This vent was, however, closed from the outside, and the birds had to lift the vent door to gain entrance to the nest. Within the park subsection of this same area in the same year, a very unusual case of adaptation to man and the disturbances created by him was observed. A nesting mallard was found in a small patch of weeds just inside a golf course fence. This nest was located between a golf course maintenance road and Ford Road, one of the busiest roads in Dearborn. To add to the disturbance, Ford Road was being widened, and heavy bulldozers and earth-moving equipment passed within ten feet of the nesting mallard; in spite of these conditions, this nest was successful.

APPENDIX E. BIRDS OF THE FIVE DETROIT STUDY AREAS

Table 1. Birds identified within each study area by subsection and year.

Species	Clark				Woodmere				Ford				Golfview				Dearborn			
	1972		1973		1972		1973		1972		1973		1972		1973		1972		1973	
	R*	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P
Blackbird, Red-winged Agelaius phoeniceus***			S**			S		S		S		S	S	S	S	S	S	S	S	S
Bluebird Sialia sialis						S														
Bunting, Indigo Passerina cyanea										S		S					S	S	S	S
Cardinal Richmondena cardinalis	S	S	S			SF			SF	SF	SW	S	SF	SF	SW	SW	SF	SF	S	SW
Catbird Dumetella carolinensis										S		S	S	S	S	S	S	S		S
Chickadee, Black-capped Parus atricapillus																		F		W
Chickadee, Boreal Parus hudsonicus																		F		
Cowbird, Brown-headed Molothrus ater						S		S	S	S			S				S	S	S	S
Creeper, Brown Certhia familiaris		S				S				S										
Crow, Common Corvus brachyrhychos						S				S				SF	S			S		S
Cuckoo, Yellow-billed Coccyzus americanus												S								S
Dove, Mourning Zenaidura macroura	S	S	S		S	S	S	S	SF	S	S	SW	SF	S	SW	SW	SF	SF	SW	SW

Table 1 (cont'd).

Species	Clark 1972 R	Clark 1972 P	Clark 1973 R	Clark 1973 P	Woodmere 1972 R	Woodmere 1972 P	Woodmere 1973 R	Woodmere 1973 P	Ford 1972 R	Ford 1972 P	Ford 1973 R	Ford 1973 P	Golfview 1972 R	Golfview 1972 P	Golfview 1973 R	Golfview 1973 P	Dearborn 1972 R	Dearborn 1972 P	Dearborn 1973 R	Dearborn 1973 P
Duck, Wood __Aix sponsa__												S						S		S
Flicker, Yellow-shafted __Colaptes auratus__		S	S		S	SF	S	S	S	SF		S	SF	SF	S			S		S
Flycatcher, Crested __Myiarchus crinitus__										S		S						S		S
Flycatcher, Least __Empidonax minimus__										S		S			S	S				S
Flycatcher, Yellow-bellied __Empidonax flaviventris__										S										
Goldfinch, American __Spinus tristis__	S								SF	S	S		SF	SF	S	S	S	SF	S	W
Grackle, Common __Quiscalus quiscula__	S	S	S	S	SF	S	S	S	SF	SF	S	S	SF	SF	S	S	SF	SF	S	S
Grosbeak, Rose-breasted __Pheucticus ludovicianus__												S	S				S	S	S	S
Gull, Ring-billed __Larus delawarensis__						S		S												
Hawk, Broad-winged __Buteo platypterus__												S								
Hawk, Sparrow __Falco sparverius__					S					S										
Heron, Great Blue __Ardea herodias__																				S

Table 1 (cont'd).

Species	Clark 1972 R	P	1973 R	P	Woodmere 1972 R	P	1973 R	P	Ford 1972 R	P	1973 R	P	Golfview 1972 R	P	1973 R	P	Dearborn 1972 R	P	1973 R	P
Heron, Green *Butorides virescens*																		S		
Hummingbird, Ruby-throated *Archilochus colubris*										S										
Jay, Blue *Cyanocitta cristata*	SF	SF	S	S	SF	SF	SW	SW	SF	SF	SW	SW	SF	SF	SW	SW	SF	SF	SW	SW
Junco, Slate-colored *Junco hyemalis*	SF	F		S		F				S	S		SF	F	SW	W	S	SF		SW
Killdeer *Charadrius vociferus*														S						
Kingbird, Eastern *Tyrannus tyrannus*													S	S		S				
Kingfisher, Belted *Megaceryle alcyon*																		S		
Kinglet, Golden-crowned *Regulus satrapa*										S										S
Kinglet, Ruby-crowned *Regulus calendula*								S	S									SF		S
Mallard *Anas platyrhynchos*						S			S	S		S		S		S	S	SF	S	S
Meadowlark, Eastern *Sturnella magna*																S				
Nighthawk, Common *Chordeiles minor*	S																			

Table 1 (cont'd).

Species	Clark				Woodmere				Ford				Golfview				Dearborn			
	1972		1973		1972		1973		1972		1973		1972		1973		1972		1973	
	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P
Nuthatch, Red-breasted <u>Sitta canadensis</u>							S													
Nuthatch, White-breasted <u>Sitta carolinensis</u>						F						S	F					SF		SW
Oriole, Baltimore <u>Icterus galbula</u>	S								S	S	S	S	S	S	S	S	S	S	S	
Ovenbird <u>Seiurus aurocapillus</u>															S					
Owl, Barred <u>Strix varia</u>																		SF		
Owl, Great Horned <u>Bubo virginianus</u>		S																		
Pewee, Eastern Wood <u>Contopus virens</u>								S		S		S						S		
Pheasant, Ring-necked <u>Phasianus colchicus</u>						S		S		S				F			S	S		SW
Pigeon (Rock Dove) <u>Columba livia</u>	SF	S	SW	S	SF	SF	SW	SW			S			S	SW		F	S	S	
Robin <u>Turdus migratorius</u>	S	S	S	S	S	SF	S	S	SF	S	S	S	SF	S	S	S	S	SF	S	S
Sandpiper, Pectoral <u>Erolia milanotos</u>																		S		
Sandpiper, Spotted <u>Actitis macularia</u>						S												S		

Table 1 (cont'd).

Species	Clark 1972 R	Clark 1972 P	Clark 1973 R	Clark 1973 P	Woodmere 1972 R	Woodmere 1972 P	Woodmere 1973 R	Woodmere 1973 P	Ford 1972 R	Ford 1972 P	Ford 1973 R	Ford 1973 P	Golfview 1972 R	Golfview 1972 P	Golfview 1973 R	Golfview 1973 P	Dearborn 1972 R	Dearborn 1972 P	Dearborn 1973 R	Dearborn 1973 P
Sapsucker, Yellow-bellied *Sphyrapicus varius*	F	S						S		S			S							
Sparrow, Chipping *Spizella passerina*						S							S							
Sparrow, Fox *Passerella iliaca*																		F		
Sparrow, House *Passer domesticus*	SF	SF	SW	SW	SF	S	SW	S	SF	S	SW	S	SF	S	SW	S	SF	SF	SW	S
Sparrow, Song *Melospiza melodia*						F			S		S		S	S	S	S	S	SF	S	SW
Sparrow, White-throated *Zonotrichia albicollis*	S	F			F	F	S			SF		S		S			SF	SF		S
Starling *Sturnus vulgaris*	SF	SF	SW	SW	SF	S	SW	SW	SF	SF	SW	SW	SF	SF	SW	SW	SF	SF	SW	SW
Swallow spp. Fl. Hirundinidae									S											
Swallow, Barn *Hirundo rustica*							S							S						
Swallow, Tree *Iridoprocne bicolor*																S				
Swift, Chimney *Chaetura pelagica*	S	S	S		S	S	S	S	S				S	S			S	S	S	
Thrasher, Brown *Toxostoma rufum*	S		S			F	S							S		S		S	S	S

Table 1 (cont'd)

Species	Clark				Woodmere				Ford				Golfview				Dearborn			
	1972		1973		1972		1973		1972		1973		1972		1973		1972		1973	
	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P	R	P
Thrush, Swainson's __Hylocichla__ __ustulata__	F					F			F	S			S		S					
Thrush, Wood __Hylocichla__ __mustelina__										S		S								S
Titmouse, Tufted __Parus__ __bicolor__										S	S						S	SF	S	SW
Veery __Hylocichla__ __fuscescens__			S							S										
Vireo, Red-eyed __Vireo__ __olivaceus__								S				S						S		S
Vireo, Warbling __Vireo__ __gilvus__														S	S					S
Warbler, Bay-breasted __Dendroica__ __castanea__			S									S								
Warbler, Black and White __Mniotilta__ __varia__								S		S								S		
Warbler, Blackburnian __Dendroica__ __fusca__										S										
Warbler, Black-throated Blue __Dendroica__ __caerulescens__			S																	
Warbler, Black-throated Green __Dendroica__ __virens__										S				S				S		
Warbler, Canada __Wilsonia__ __canadensis__				S								S								

Table 1 (cont'd).

Species	Clark 1972 R	P	Clark 1973 R	P	Woodmere 1972 R	P	Woodmere 1973 R	P	Ford 1972 R	P	Ford 1973 R	P	Golfview 1972 R	P	Golfview 1973 R	P	Dearborn 1972 R	P	Dearborn 1973 R	P
Warbler, Cape May <u>Dendroica</u> <u>tigrina</u>																	S	S		
Warbler, Cerulean <u>Dendroica</u> <u>cerulea</u>																		S		
Warbler, Chestnut-sided <u>Dendroica</u> <u>pensylvanica</u>										S		S								
Warbler, Magnolia <u>Dendroica</u> <u>magnolia</u>										S	S		S							
Warbler, Myrtle <u>Dendroica</u> <u>coronata</u>					F							S		S			S	SF	S	
Warbler, Nashville <u>Vermivora</u> <u>ruficapilla</u>			S						S	S		S		S			S	S		S
Warbler, Yellow <u>Dendroica</u> <u>petechia</u>						S			S									S		S
Waxwing, Cedar <u>Bomrycilla</u> <u>cedrorum</u>						S					S	S	F		S	S	S	SF		S
Woodcock, American <u>Philohela</u> <u>minor</u>						S												S		
Woodpecker, Downy <u>Dendrocopos</u> <u>pubescens</u>									S	S		W	S				S	SF		S
Woodpecker, Hairy <u>Dendrocopos</u> <u>villosus</u>		F				S				S		S	S	S			F	S		SW
Woodpecker, Red-headed <u>Melanerpes</u> <u>erythrocephalus</u>						S		S		S		S		S				S		

Table 1 (cont'd).

Species	Clark 1972 R	Clark 1972 P	Clark 1973 R	Clark 1973 P	Woodmere 1972 R	Woodmere 1972 P	Woodmere 1973 R	Woodmere 1973 P	Ford 1972 R	Ford 1972 P	Ford 1973 R	Ford 1973 P	Golfview 1972 R	Golfview 1972 P	Golfview 1973 R	Golfview 1973 P	Dearborn 1972 R	Dearborn 1972 P	Dearborn 1973 R	Dearborn 1973 P
Wren, House *Troglodytes aedon*									S	S							S	S		S
Yellowthroat *Geothlypis trichas*									S											

* R = residential subsection; P = park subsection.

** S = spring-summer survey; F = fall survey; W = winter survey.

*** Scientific names from American Ornithologists' Union (1961).

APPENDIX F. SCIENTIFIC NAMES OF PLANTS IDENTIFIED DURING THE PRESENT STUDY

Table 1. Plants of the upper stratum.

Common Name	Scientific Name*
Ailanthus	Ailanthus altissima
Apple	Pyrus malus
Ash, Black	Fraxinus nigra
Ash, Red	Fraxinus pennsylvanica
Ash, White	Fraxinus americana
Basswood spp.	Tilia spp.
Beech	Fagus grandifolia
Beech, Blue	Carpinus caroliniana
Birch, Paper	Betula cordifolia
Birch, Yellow	Betula lutea
Buckthorn spp.	Rhamnus spp.
Butternut	Juglans cinerea
Cedar, White	Chamaecyparis thyoides
Cherry spp.	Prunus spp.
Coffee-tree, Kentucky	Gymnocladus dioica
Cottonwood	Populus deltoides
Crabapple spp.	Pyrus spp.
Dogwood, Flowering	Cornus florida
Elder, Box	Acer negundo
Elm, American	Ulmus americana
Fir, Douglas	Pseudotsuga douglasii
Ginkgo	Ginkgo biloba
Gum, Black	Nyssa sylvatica
Gum, Sweet	Liquidambar styraciflua
Hackberry	Celtis occidentalis
Hawthorn spp.	Crataegus spp.
Hemlock	Tsuga canadensis
Hickory, Pignut	Carya glabra
Hickory, Shagbark	Carya ovata
Holly	Ilex opaca

Table 1 (cont'd).

Common Name	Scientific Name
Hornbeam, Hop	Ostrya virginiana
Horse-chestnut	Aesculus hippocastanum
Locust, Black	Robinia pseudoacacia
Locust, Honey	Gleditsia triacanthos
Locust, Moraine	Gleditsia triacanthos inermis
Magnolia, Cucumber	Magnolia acuminata
Magnolia spp.	Magnolia spp.
Maple, Norway	Acer platanoides
Maple, Red	Acer rubrum
Maple, Silver	Acer saccharinum
Maple, Sugar	Acer saccharum
Mimosa	Albizzia julibrissin
Mountain-ash	Pyrus americana
Mulberry spp.	Morus spp.
Oak, Black	Quercus velutina
Oak, Bur	Quercus macrocarpa
Oak, Pin	Quercus palustris
Oak, Red	Quercus borealis maxima
Oak, Swamp White	Quercus bicolor
Oak, White	Quercus alba
Olive, Russian	Elaeagnus commutata
Peach	Prunus persica
Pear	Pyrus communis
Pine, Austrian	Pinus nigra
Pine, Red	Pinus resinosa
Pine, Scotch	Pinus sylvestris
Pine, White	Pinus strobus
Plum spp.	Prunus spp.
Redbud	Cercis canadensis
Sassafras	Sassafras albidum
Spruce, Blue	Picea engelmanni
Spruce, Norway	Picea abies
Spruce, White	Picea glauca

Table 1 (cont'd).

Common Name	Scientific Name
Sycamore	Platanus occidentalis
Tulip-tree (Yellow Poplar)	Liriodendron tulipifera
Walnut, Black	Juglans nigra
Willow spp.	Salix spp.
Wisteria spp.	Wisteria spp.

* Scientific names from Gleason (1968) and Wyman (1965, 1969).

Table 2. Plants of the lower stratum.

Common Name	Scientific Name*
Alder, Black	Alnus glutinosa
Arbor Vitae	Thuja occidentalis
Ash spp.	Fraxinus spp.
Azalea spp.	Rhododendron spp.
Barberry spp.	Berberia spp.
Beautybush	Kolkwitzia amabilis
Boxwood	Buxus sempervirens
Burningbush	Euonymus alatus
Cherry, Choke	Prunus virginiana
Cherry, Manchu	Prunus tomentosa
Contoneaster spp.	Contoneaster spp.
Currant spp.	Ribes spp.
Dogwood, Red-osier	Cornus stolonifera
Dogwood, Red-panicle	Cornus racemosa
Dogwood spp.	Cornus spp.
Elderberry, Common	Sambucus canadensis
Euonymus spp.	Euonymus spp.
Forsythia spp.	Forsythia spp.
Grape spp.	Vitis spp.
Holly-grape, Oregon	Makonia aquifolium
Honeysuckle spp.	Lonicera spp.
Juniper spp.	Juniperus spp.
Lilac spp.	Syringa spp.
Maple, Japanese	Acer palmatum
Maple spp.	Acer spp.
Mock-orange spp.	Syringa spp.
Ninebark spp.	Physocarpus spp.
Olive, Russian	Elaeagnus commutata
Pine, Mugho	Pinus mugo
Privet spp.	Ligristrum spp.
Quince spp.	Chaenomeles spp.
Raspberry spp.	Rubus spp.
Rhododendron spp.	Rhododendron spp.

Table 2 (cont'd).

Common Name	Scientific Name
Rose-of-Sharon	Hibiscus syriacus
Rose spp.	Rosa spp.
Smokebush	Cotinus coggygria
Spicebush	Lindera benzoin
Spirea spp.	Spiraea spp.
Viburnum spp.	Viburnum spp.
Witch hazel	Hamamelis virginiana
Willow spp.	Salix spp.
Yew spp.	Taxus spp.
	Pieris japonica

*Scientific names from Gleason (1968) and Wyman (1965, 1969).