

ECOLOGY OF THE SUMMER NESTING BIRDS
OF THE McCURTAIN GAME PRESERVE

by

WILLIAM ALFRED CARTER

Bachelor of Science in Education
East Central State College
Ada, Oklahoma
1957

Master of Science
Oklahoma State University
Stillwater, Oklahoma
1960

Submitted to the Faculty of the Graduate School of
the Oklahoma State University
in partial fulfillment of the requirements
for the degree of
DOCTOR OF PHILOSOPHY
August, 1965

NOV 24 1965

ECOLOGY OF THE SUMMER NESTING BIRDS
OF THE McCURTAIN GAME PRESERVE

Thesis Approved:

J. M. Baumgartner

Thesis Adviser

Geo. A. Moore

Roy W. Jones

L. Herbert Bureau

H. J. Featherly

J. M. Boyer

Dean of the Graduate School

592729

ACKNOWLEDGEMENTS

Appreciation is expressed to my major adviser, Dr. F. M. Baumgartner, who has freely given his time and counsel during the course of this research project. Appreciation is also expressed to other members of my committee, Dr. L. H. Bruneau, Dr. R. W. Jones, Dr. H. I. Featherly, Dr. G. A. Moore. Dr. D. D. Dwyer and Dr. W. I. Irwin were helpful in the early stages of the study.

I wish to thank the administration of the Oklahoma Department of Wildlife Conservation for permission to carry out the field study and use the facilities in the Preserve. Special thanks are due Mr. Eugene Woods, Preserve manager, and Mr. Glen Scott, assistant, and their families for cooperation and courtesies extended during my stay in the Preserve.

TABLE OF CONTENTS

Chapter	Page
I. INTRODUCTION	1
II. THE McCURTAIN GAME PRESERVE	3
History of the Preserve	3
Description of the Preserve	4
Soils	5
Geology	7
Climate	9
Vegetation	9
III. METHODS	17
Avian Population Analysis Methods	17
Field Procedures	22
Vegetation Analysis Methods	23
IV. SUMMER NESTING BIRD POPULATIONS AND THE PLANT COMMUNITIES	25
The River Bottom Community	26
Vegetative Composition	26
Avian Populations	26
The Stream Bottom Community	29
Vegetative Composition	29
Avian Populations	33
The Upland Oak-Pine Community	33
Vegetative Composition	33
Avian Populations	36
V. ANNOTATED LIST OF SPECIES	38
VI. SUMMARY AND CONCLUSIONS	53
Literature Cited	58

LIST OF TABLES

Table	Page
I. Ten-year Average (1954-1963) of Monthly Precipitation Totals for Carter Mountain Forest Service Tower . . .	10
II. Ten-year Average (1954-1963) of the Average Monthly Maximum and Average Monthly Minimum Temperature (°F)	11
III. Dominants and Codominants of the River Bottom Forest . .	27
IV. Lower Story Plants of the River Bottom Forest	28
V. Nesting Birds of the River Bottom Forests.	30
VI. Dominants and Codominants of the Stream Bottom Forests .	31
VII. Lower Story Plants of the Stream Bottom Forests.	32
VIII. Nesting Birds of the Stream Bottom Forests	34
IX. Dominants and Codominants of the Upland Forests.	35
X. Lower Story Plants of the Upland Forests	35
XI. Nesting Birds of the Upland Forests	37
XII. Comparison of the Nesting Bird Populations in the Major Habitats of the McCurtain Game Preserve, 1961-1962.	53

LIST OF FIGURES

Figure	Page
1. Topographic Map of the McCurtain Game Preserve and Area.	6
2. Average Annual Precipitation (inches)	12
3. Average Annual Temperature (°F)	13
4. Carolinian and Austroriparian Biotic Provinces	15
5. Natural Vegetative Types of Oklahoma.	16

CHAPTER I

INTRODUCTION

Man's effect on his environment can be fully realized only when we are able to compare an area, relatively undisturbed for a long time, with one bearing the marks of human culture. Certainly, neither the native flora nor fauna remains stable in any area--with or without the direct influence of man. Yet the marked differences in the density, distribution, and species composition of the biota between a virgin woodland and a neighboring area that has been cut-over are so striking that they may be readily detected by the most casual observer. Man has been ruthless in his use of the bountiful natural resources of our nation. Few areas remain in natural condition for future generations to study so they may appreciate the vast changes in their environment.

This paper reports an ecological investigation of the avifauna of a virgin woodland area. Field studies during the summer of 1961 and 1962 were conducted in the McCurtain Game Preserve near Bethel, in southeastern Oklahoma. The purpose of this paper is to describe the summer breeding bird populations of the important communities and to point to certain ecological relationships between these populations and their communities. Primary attention is directed to: (1) estimates of the breeding bird populations, (2) the type of habitats which these populations occupy for breeding and foraging territories, (3) and the community structure at the western fringe of the Pine-Oak forest.

For ornithologists and other biologists, this region is of particular interest, since it represents a virgin timber area and is in the western limits of this formation. It is to be regretted that more detailed work has not been done in other biological fields within the river-bottom forests of the Preserve, as this association will soon be inundated by waters of the Broken Bow Reservoir. Construction of big dams, lumbering practices, and over-utilization by cattle and hogs in the river bottom areas of eastern Oklahoma are rapidly reducing the area of this biotic association and leaving the remainder unsuitable for many types of wildlife.

CHAPTER II
THE McCURTAIN GAME PRESERVE

History of the Preserve

The McCurtain Game Preserve includes about 15,220 acres of mountainous land in north-central McCurtain County, Oklahoma. It is the only Oklahoma state-owned area of virgin oak-pine forests; and, according to the director of the Southern Forest Experiment Station, New Orleans, Louisiana (Wheeler 1961) there is ". . . no comparable area of virgin timber in the Southeastern (Forest Service) Region." This then is a unique area for scientific research and one of high aesthetic value.

Purchase of the area was started as early as 1918, with the buying of unallotted Indian lands from the Choctaw Nation and was completed by 1924 through the influence of Governor Robert L. Williams.

The Preserve was placed under the administration of the Oklahoma Game and Fish Department (now the Department of Wildlife Conservation) in 1927. Except for the boundary fence and maintenance roads, no cultural or management techniques were undertaken on the Preserve until 1950. During that year, a block of 40 acres was fenced in the central area of the Preserve to provide a holding pen for the turkey restocking program. The Preserve has been protected from all forms of hunting and from fire, except for small burns, since 1926. Cattle penetrate the area from the surrounding open range when flooding or vandalism damages the fences; however, their numbers are small and they are promptly removed.

No attempt is made to remove swine unless they become too numerous.

Predator control has been maintained in the Preserve on a limited basis by the manager and/or his assistant. This has been limited to trapping of bobcats, gray foxes, coyotes and wolves (?). Dogs that may stray into the Preserve are caught and returned to their owners since they are used to gather swine from the open range.

The U. S. Army Corps of Engineers began survey work in the virgin river-bottom areas of the Preserve for the Broken Bow Reservoir during the summer of 1963. The waters of the reservoir will completely destroy the virgin river-bottom hardwood forest habitat within the Preserve as well as some of the stream-bottom habitat areas of the Preserve.

The opening of the Broken Bow Reservoir for public recreation will have a marked effect on the remote Preserve. Inundation will destroy the most unique areas of the Preserve, the virgin river-bottom hardwood forest. Enforcement of trespassing and hunting regulations and wilderness protection for the remainder of the Preserve will be made difficult as improvement of roads leading to the lake area increase the number of visitors. Intelligent groundwork should be made by the Wildlife Conservation Commission to assure adequate protection of the remaining areas of the Preserve.

Description of the Preserve

The Preserve lies in the southern portion of the Ouachita Uplift. The terrain varies from moderately rugged or rather steeply rolling, to precipitous. Characteristically it is composed of rough east-west ridges; elevations vary from 561 feet above sea level along the Mountain Fork of

the Little River to 1,363 feet on Pine Mountain in the east central part of the Preserve (Fig. 1).

Drainage of the Preserve is entirely part of the Mountain Fork River system. Major smaller creeks are shown on the map of the Preserve (Fig. 1).

Soils

The soil materials in the valleys consist of shales and fill material; and the ridges are composed of sandstones, shales and slate. Streams of high gradient are actively cutting the narrow flood plains. Bottomland soils are leached, poorly drained, and relatively infertile. There are small prairie openings and areas that support savannah on the more clayey soil materials.

The strongly leached, acid Red-Yellow Podzolic soils of this area were developed from gray and brown shales and sandstone. Surface soils are generally light-colored. Soils developed from shales have silty surfaces and clayey, mottled subsoils. Those developed from sandstones are sandy loams with brighter, less mottled subsoils. Most of the soils are low in potassium, phosphorus, and nitrogen. (Gray and Galloway 1959).

The Hector-Pottsville association occurs on the mountain areas. Enders-Conway-Hector soils are found in the valley floors and broader bedrock plains. Atkins-Pope are the principal soils of the narrow bottomlands.

Hector is a shallow, light brown soil over sandstones. Pottsville is a shallow, light-colored loam over clay-shales. The two soils, considered to be shallow (less than ten inches), commonly occur together on hillsides of banded sandstones and shales. The shallow Hector soils



Figure 1. Topographic Map of the McCurtain Game Preserve and Area.
 (from: U. S. Geological Survey map of the Smithville
 Quadrangle, McCurtain County, Oklahoma, 1960)

are found on the narrow sandstone ridges and valley escarpments.

Much of the mountain area is rough, stony land, with some of the formations steeply tipped, often 60° or more from the horizontal. The exposed edges of the rocks enable tree roots to grow between the layers. This, together with the high precipitation, results in superior forest sites. By contrast, in areas where the Hector-Pottsville association is on horizontally bedded rocks, very poor forest production sites result. Ridges of White Oak and Little White Oak Mountain fall into this classification. Shale bands across the mountain slopes produce open or savannah areas with increased grass ground cover.

Enders and Conway soils have developed in the valleys from clayey rocks on gentle slopes. These may be considered moderately deep (20 to 36 inches) soils. Both are droughty, have low fertility and rocky surfaces are common. The Atkins soils are gray clay loams of the level, poorly drained bottoms. Pope soils, positioned on the well-drained natural levees in the same bottoms, are brown, sandy loams. The Atkins-Pope soils have a usual depth of over 36 inches, are subject to overflow, and have low fertility.

Geology

The Ouachita Mountains of Oklahoma were first studied geologically by Charles W. Honess (1923). In his study, Honess mapped about 1,000 square miles by walking all the half-section lines that ran in a north-south direction, making geological notes and collecting rock specimens as he traveled. His map and discussion included the Preserve area. Recent detailed work in Beavers Bend State Park (Pitt and Spradling 1963) a few miles south of the Preserve, showed Honess' pioneer work essentially correct.

Surface or near surface rocks which influence the soil and vegetative associations within the Preserve include formation from the Ordovician to Recent geologic periods. These include: (1) Alluvium Formation of the Recent geologic era characterized by recent stream deposits of sand, silt and clay; (2) Trinity Formation of Cretaceous geologic era characterized by loosely consolidated sandstones, gravels, conglomerate and clay; (3) Stanley Shale Formation of the Mississippian era characterized by bluish-green silty shale with local tuff and sandstone beds up to 6000 feet in thickness; (4) Arkansas Novaculite Formation with depths varying from 250 to 540 feet of which the Upper Division is of the Mississippian era and is characterized by massive beds of blue to green chert and dark shale, the Middle Division between the Mississippian and Devonian eras with dark-green shale and thin beds of chert, and the Lower Division of the Devonian era with white novaculite, shale and rhodochrosite nodules near the top; (5) Missouri Mountain Shale Formation of the Silurian era with a depth of about 50 feet and characterized by green and red fissile shale with local thin beds of gray sandstone; (6) Blaylock Sandstone Formation of the Silurian era with depths to 885 feet and characterized by gray-green quartzitic sandstone with intercalated green to black shale; (7) Polk Creek Shale Formation of the Ordovician era with depths of 100 to 150 feet and characterized by black, graptolitic shale with local beds of black chert; and (8) Bigfork Chert Formation of the Ordovician era with depths of 400 to 800 feet and characterized by black, weathering to blue, massive chert interbedded with black graptolitic shale. The Stanley Shale Formation is the most extensive formation in the Preserve.

Climate

The Preserve is located in the area of Oklahoma which receives the highest annual rainfall (Fig. 2). Approximately 75% of the rainfall occurs during the growing season. As the precipitation records are not complete for Hee Mountain Tower, located one-half mile north of the Preserve, data from Carter Mountain Tower, located about 10 miles south of the Preserve, are used in this paper. Records for a 10-year (1954-1963) average monthly rainfall are shown in Table I. Extremes for the 10-year period show a high of 12.42 inches in October, 1954 and a low of 0.31 inches in October, 1963. Rivers and streams in the area may rise rapidly in response to heavy rainfall during short periods of time, but the run-off is rapid.

The 10-year temperature records showed the highest monthly average maximum of 93 F in July and the lowest monthly average minimum of 28 F in January as shown in Table II. A 24-year record showed an average annual frost-free period of about 233 days with the last killing frost usually occurring the third week in March, and the first killing frost in the fall occurring about the second week in November. Temperature data from the Smithville station were used since they alone were complete. Published records of the U. S. Department of Commerce were consulted for all climatic data.

The average annual temperature (Fig. 3) and precipitation data (Fig. 2) for southeastern Oklahoma were similar to those for the southeastern states..

Vegetation

The Austroriparian Biotic Province (Dice 1943), characterized

TABLE I

Ten-Year Average (1954-1963) of Monthly Precipitation
Totals for Carter Mountain Forest Service Tower

January	2.80
February	2.99
March	3.96
April	4.36
May	5.35
June	3.08
July	4.88
August	4.33
September	4.29
October	4.38
November	3.48
December	3.36
TOTAL	47.26

TABLE II

Ten-Year Average (1954-1963) of the Average
Monthly Maximum and Average Monthly
Minimum Temperatures ($^{\circ}$ F)

	<u>Maximum</u>	<u>Minimum</u>
January	51.48	27.78
February	57.31	33.19
March	63.55	38.03
April	74.02	49.26
May	81.60	57.45
June	87.46	64.06
July	92.66	68.59
August	92.45	67.17
September	86.28	60.78
October	76.13	51.07
November	63.43	38.10
December	54.66	32.56



Figure 2: Average Annual Precipitation (inches)
(U.S.D.A. 1941)



Figure 3: Average Annual Temperature (°F)
(U.S.D.A. 1941)

by subclimax pine forests within the eastern deciduous forests (Fig. 4), is found within this major climatic area. The Preserve is located in the western limits of this Province.

The vegetative units within the Preserve may be delimited according to the topographic and soil character of the site. The steep north slopes and the protected ravines are characterized by white oak, red oak, and flowering dogwood. The ridges are characterized by mature stands principally of short-leaf pine, but include post oak, white oak, and blackjack oak. The south slopes have essentially the same composition as the ridges. A large portion of the Preserve manifests an intermediate condition, with variable sites which show a composite of other upland areas. The virgin river bottom hardwood forests are dominated by holly, white oak, gum, hickory, ash, and baldcypress with cane, spicebush and some panic grasses for ground cover. The stream bottom woodlands typically have a composition similar to that of the north slopes. Detailed vegetative analysis of the avian habitats are given in Chapter IV.

It is of major importance to recall that the avian habitats are essentially of the same life-form in all areas of the Ouachita Uplift (Fig. 5). Outside of the Preserve, mature virgin stands are found in very limited areas.

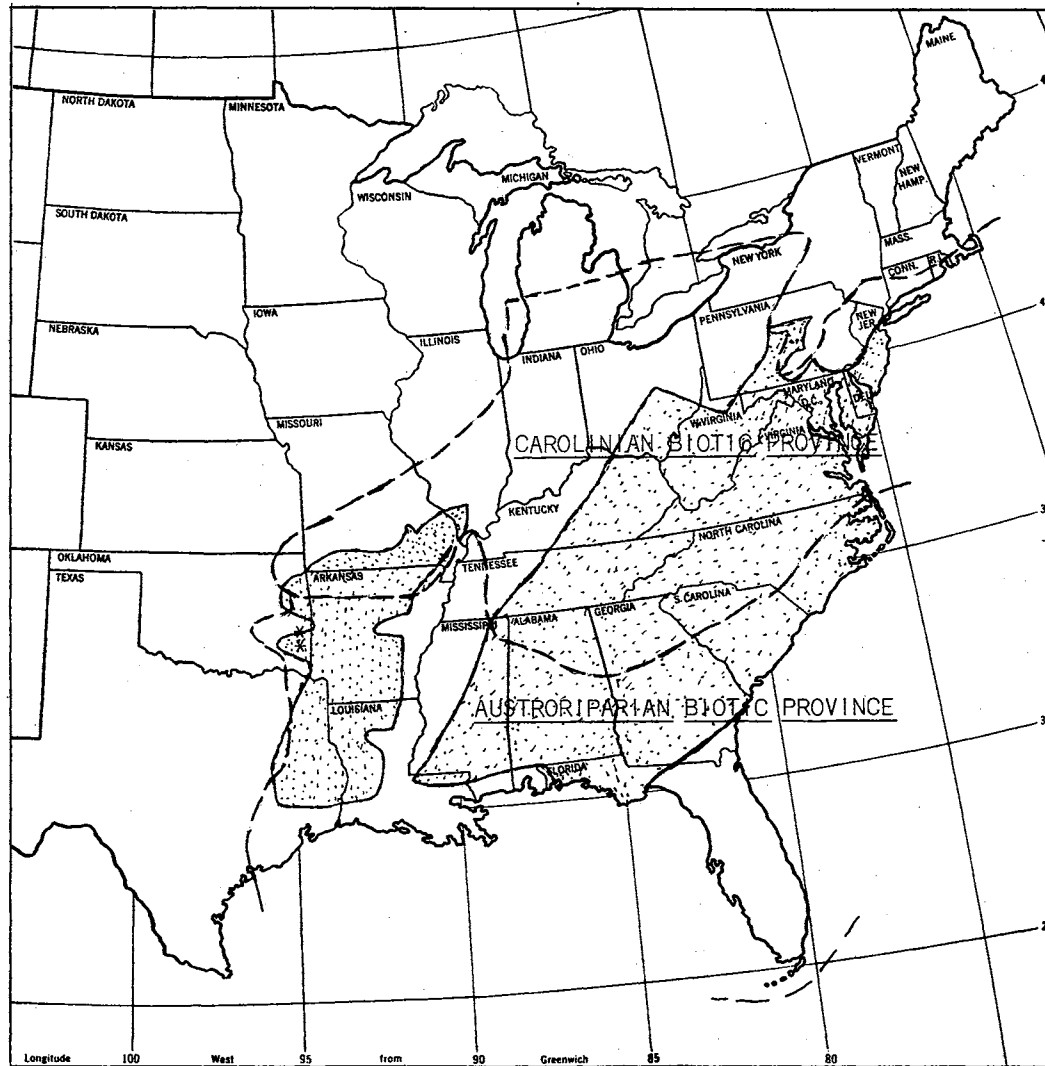


Figure 4: Carolinian and Austroriparian Biotic Provinces.
 Stippled area shows distribution of shortleaf pine within
 the eastern deciduous forests.
 (After: Dice 1943; U.S.D.A. 1949)

CHAPTER III

METHODS

Avian Population Analysis Methods

Prior to the end of the nineteenth century, quantitative studies of avian populations were largely limited to indicating whether a species was abundant, common, or rare; these ratings were based largely on the general impressions of the field observer. The delineation of geographic ranges and description of new races monopolized the attention of ornithologists and were a necessary preliminary to all other field studies.

The United States saw some of the earliest beginnings in the quantitative study of bird populations and still retains much of the leadership in this field. Kendeigh (1944) has given the historical development of the measurement of bird populations in the United States.

The present study is an attempt to obtain the absolute abundance or the actual avian breeding populations of sample areas and to project these figures for an estimate of the total breeding bird populations for the Preserve. As this study was primarily concerned with obtaining the most dependable results possible, a combination of various census techniques was employed. A brief review of some of the problems encountered in measurement of breeding bird populations will be given in order to fully justify the methods chosen for this study.

The size of the sample plot has received considerable attention, varying with workers and circumstances. Nice (1927) censused a narrow strip of woods along a stream about one-half mile long and covering 40 acres. Tuovinsen (1936) covered 64 acres of spruce, pine, and birch woods. In mixed deciduous and evergreen forests, Schiermann (1930 and 1934) found 60 acres too large and so used 15-acre quadrats. Zimmerman (1932) obtained counts of birds over 10 years in a 54-acre marsh. Lack (1935) with the help of cooperators censused 1,700 acres of heath and grassland. Williams (1936) found an area of 65 acres of deciduous forest about the maximum size he could accurately census in a day. Saunders and students (1938) reported censuses in four types of forests totaling 225 acres. Kendeigh (1941) reported the breeding population on 50 acres of prairie and stated that a larger area could have been covered as effectively. Breeding bird censuses in the Audubon Field Notes cover areas from less than three acres to over 250 acres in size.

The very high densities of nesting populations reported by Grosvenor (1916), Whitaker (1916), and Pitelka (1942) were due to their sampling of small areas of optimum habitat. Doubtless many, if not all, of the birds that they included in their censuses regularly covered a much larger area.

Sample plots must be large enough to include the activities of all the species involved, except possibly the larger predatory forms. The size of the sample area yielding maximum data, of course, varies with the method to be employed, type of community or habitat, number of observers, abundance of birds, and available area of uniform habitat (Kendeigh 1944).

Schiermann (1930 and 1934) based most of his censuses of forest

birds on the actual location of nests in the small sample plots. Hicks (1935) found nests of 76% of the pairs that he records for an 80-acre stream valley. Based largely on location of nests, Beecher (1942) made an intensive study of 482 acres of marsh and upland over a three-year period. In 1937, his year of most intensive effort, over 85% of the nests of the breeding birds were actually found. The approximate location of the remaining nest territories was obtained by repeated mapping of singing males.

It might seem that finding nests is a positive and accurate method of censusing bird populations. This is not always true. Although some species have only one brood per year, many have two or more for which they either build separate nests or reuse old nests. Some nests are built and abandoned when the eggs or young are disturbed. Nest finding is a time-consuming effort at best and all but impossible in small birds that nest high in the forest crown cover or in large forms that range over extensive territories. Too few nests of known breeding birds can actually be located, and those that are found are usually by accident or after an undue expenditure of time. This method is not practicable in forest habitats, but gives important supplemental data in conjunction with other methods.

The method of counting singing males very early in the morning, when every male bird is usually in full song and near the nest site, has been used in early studies in the United States by Cooke (1927) and in Europe by Kalela (1938), Palmgren (1930 and 1931), and Schiermann (1930 and 1934).

There have been serious criticisms of counting singing males as representing nesting pairs in that a sizeable, but unknown, number may be unmated. Kendeigh (1941) found 9% of the population of males on territories to be unmated. In some species, after they acquire a mate and start nesting, males often reduce the frequency of, or stop singing

altogether. The amount and intensity of singing, hence their conspicuousness, varies among species. In spite of these objections the recording of singing males is essential in any method, although such data should be supplemented with other information. Often it is impossible or very difficult to make certain whether a male, singing but unmated at one time, actually remains unmated throughout the breeding season; thus, it is usually justifiable to consider that all singing males represent at least potential breeding pairs. Kalela (1938) has shown this to be a reasonably reliable index of possible carrying capacity even if a few males never do mate.

In species which typically rear two broods, an unknown number of both sexes may mate and nest for only one of the two breeding periods (Kendeigh 1941a). Further complications ensue, when one considers that a small part of the population may not appear during the season, although present in former years and nesting in the area in subsequent years (Nice 1941; Kendeigh 1941a). The point is, when the breeding population is measured during only part of the season, the total population is not accurately characterized. At any one time, the percentage of non-breeders in the total population undoubtedly varies in different species and may often be a substantial, although an unknown amount. This must be kept in mind in evaluating the population density even though the data are mostly compiled from nesting pairs and singing males.

The use of maps in recording bird censuses is very desirable. Williams (1936) developed, through the use of maps, a good method, later followed by Kendeigh (1941a and 1944), of censusing by the approximate delimitation of territories. Each week he recorded on a new map the location of each bird sighted in the study area. At the end of the season, a composite map was compiled for each species, showing the

location of all individuals seen on all trips. These locations fell in groups indicating territories, thus permitting with some accuracy, an estimation of the number of pairs in that area. This method does not distinguish unmated birds nor does it reconcile the plasticity of territories when second broods are raised. The true size and boundaries of territories cannot be determined with accuracy unless numerous trips are made, but this is not the main purpose of the method.

The number of times a plot should be surveyed for a breeding bird census is of prime importance. Palmgren (1930) carefully investigated the number of trips required for a "complete" census. Periodic trips were made to a specific area and the total population of birds present, was computed from the maximum number of each species recorded on any single trip regardless of the trip on which it was obtained. Thus, he found that one survey through an area ordinarily listed approximately 62% of the total population, twice over the area increased the count to 80%, three times to 91%, and four times to 96%. He had such confidence in these figures for his region that he has reported populations based on a single survey with the figures corrected accordingly (1931).

During the summer of 1942 at the Edmund Niles Huyck Preserve, Rensselaerville, New York, Kendeigh (1944) checked the correction factors used by Palmgren. A census of the breeding population in a 21-acre hemlock-beech forest was made by repeated and systematic cruising over the entire area during the height of the breeding season. Compared with Palmgren's figures, one more survey was required to obtain approximately the same percentage of the ultimate total population, that is, five trips instead of four were required to give 96% of the total population.

The procedure for computation of population density followed in the present study was to determine the population density in selected com-

munities that were representative of the Preserve. The total population in the Preserve was computed after the area covered by each of the various types of communities was determined. There were several difficulties encountered in this procedure. Major community types vary in minor inconspicuous ways which may affect the density of the avifauna, but which often cannot be properly evaluated without first measuring the bird population. There are many varying types of vegetation communities which may or may not coincide with differences in the population of birds. Finally, the measurement of the area covered by each community is a difficult undertaking.

The proper designation and delimitation of the various types of communities is a matter of great importance in this type of study. A community, in the ecological sense, is a unit organization of plants and animals with common characteristics throughout. Recognition, description, and naming of communities involves the collection and recording of complex data, proper experience and knowledge of the literature (Shelford 1926 and 1963; Weaver and Clements 1929; Clements and Shelford 1939). Since the life-form of a plant varies more or less with the species, it is desirable to designate each community, not just by the general life-form or type of dominant vegetation, but also by two or three of the most important species. When the study unit is the community, there must be a complete description of each community concerned.

Field Procedures

A review of aerial photographs and of a topographic map of the Preserve was made in late June, 1960, prior to an intensive field survey on 2, 3, and 4 July 1960. Further study of field notes, aerial photos and topographic maps resulted in the tentative selection of study areas. When actual field investigations were initiated in June 1961, three areas

were selected for intensive study. Their selection was based on the following points: areas were (1) representative of the three major plant communities in the Preserve; (2) not disturbed by roads, fence lines or other maintenance improvements of the Preserve; (3) of uniform life-form and were surrounded by identical community type in order to eliminate edge effect; (4) accessible from the headquarters area where I maintained quarters; and (5) of adequate size for uniform plots.

The boundaries of these areas were marked. The size of each plot was determined by use of steel tape, compass and aerial photographs. A sketch map of each plot was used each time an area was censused. These maps included any distinctive landmark which helped pinpoint the exact locality. The first few census runs of the summer of 1961 added several points to these maps that made them more beneficial for the later studies.

Field data were noted on the maps to show approximate locations of singing males, active nest sites, young out of the nest, adults carrying food, family groups, or any other behavioral activities or signs that would indicate nesting.

The areas were censused from 5 a.m. to about 8 a.m. I found that the activity of singing males for most species had decreased by 7:30 a.m. to 8:30 a.m. to the point that counts were invalid. Observations on other activities associated with breeding could be made after that time.

Vegetation Analysis Methods

The belt transect sampling method (Weaver and Clements, 1929; Lutz 1930) was used to determine the vegetative composition of the trees and shrubs in the sample plots. The belt transect is a continuous narrow strip of uniform width and considerable length that gives a cross section

of the vegetation. The transect lines were permanently marked. The width of the transect lines was 20 meters for trees and two meters for shrubs. In the upland samples with a large area of uniform community type, the length of the transect line was increased until the percentage composition was not varied when the last segment was added. The river bottom and stream bottom plots were sampled by three transect lines running at right angles to the plots. Locations of these transect lines and the results are given in detail in the following sections.

CHAPTER IV

SUMMER NESTING BIRD POPULATIONS AND

THE PLANT COMMUNITIES

Considering the distribution of local bird species, the predominant habitats, preferred for breeding activities, are upland forests, river bottom forests and stream bottom woodlands. Some plant communities, less extensive than others, have local distributions throughout the Oak-Pine Formation. The more obvious in this respect are the isolated dwarfed forests and the extensive clearings made by man. These, however, are not found in the Preserve. Lindzey, studying the deer in the Preserve (1950), recognized six game (habitat) types within the Preserve.

It must be realized that the expression "habitat", as used in the present paper, is no more than an arbitrary designation of one or several plant associations which some bird species seem to prefer for their nesting activities. Thus, the habitats described here represent crude approximations of, or indices to, unknown attributes of the environment to which specific bird species respond. In general, the avian habitats of the Preserve appear to reflect the structure and physiognomy of the dominant vegetation, rather than the species composition of individual plant associations--a point well known to ecologists and well demonstrated by Pitelka (1941) for the North American bird fauna.

The River Bottom Community

Vegetative Composition

The study area of this habitat type included that portion of the river bottom east of the Mountain Fork River from the low-water bridge north to the Preserve fence. The 35-acre study area was located in Section 4, Range 25 East, Township 3 South. Elevation was 560 feet above sea level. One-half mile of edge occurs along the river while the other sides of the study area are bounded by similar river bottom habitat.

The closure of the forest crown cover of this community varies from 50% to 100%. The frequency of occurrence and basal area of the dominant and codominant trees is given in Table III. The frequency of occurrence of the common lower story plants is given in Table IV. The ground cover is sparse, composed chiefly of: Panicum sp., Smilax spp., spicebush (Lindera benzoin), and cane (Arundinaria gigantea). A high percentage of the river bottom forest floor is open, bare ground or covered with river drift materials.

Avian Populations

The river bottom community is the most important one of the Preserve for the study of bird ecology as it supports the greatest total biomass. The floral and faunal composition make this a unique feature of the Preserve. The density of the vegetation and the diversity of the avian species in this habitat required the greatest amount of field study time of any of the study areas. Therefore, the estimates have a greater degree of accuracy. Studies in various areas of this community other than the study area show remarkable uniformity in proportions of species.

TABLE III

Dominants and Codominants of the River Bottom Forest

<u>Species</u>	<u>Frequency of Occurrence (%)</u>	<u>Basal Area (sq.ft.)</u>	<u>(%)</u>
American Holly, <u>Ilex opaca</u> Ait.	34	12.4	19.7
White Oak, <u>Quercus alba</u> L.	19	11.7	18.5
Sweet gum, <u>Liquidambar styraciflua</u> L.	9	13.2	20.9
Mocknut Hickory, <u>Carya tomentosa</u> Nutt.	8	3.7	5.8
Sourgum, <u>Nyssa sylvatica</u> Marsh.	5	6.1	9.6
Ash, <u>Fraxinus</u> sp.	5	.9	1.4
Baldcypress, <u>Taxodium distichum</u> (L.) Richard.	4	6.8	10.8
Hornbeam, <u>Ostrya virginiana</u> (Mill.) K. Koch	3	-	-
Ironwood, <u>Carpinus caroliniana</u> Walt.	3	.6	.9
TOTAL		63.1	

TABLE IV

Lower Story Plants of the River Bottom Forest
(d.b.h. less than 4"; > 1 m. high)

<u>Species</u>	<u>Frequency of Occurrence (%)</u>
Ironwood, <u>Carpinus caroliniana</u> Walt.	16
Ward Willow, <u>Salix caroliniana</u> Michx.	14
Mocknut Hickory, <u>Carya tomentosa</u> Nutt.	9
Hornbeam, <u>Ostrya virginiana</u> (Mill.) K. Koch	9
Buttonbush, <u>Cephalanthus occidentalis</u> L.	6
Grape, <u>Vitis</u> sp.	5
Flowering Dogwood, <u>Cornus florida</u> L.	3
Sweetgum, <u>Liquidambar styraciflua</u> L.	2
Red Oak, <u>Quercus rubra</u> L.	2
Baldcypress, <u>Taxodium distichum</u> (L.) Richard.	2

There is very little disparity between the counts made during the two summers.

The estimates of species in the study area and the projected estimates for the 200 acres of this community are given in Table V. A plus sign (+) is used to indicate species which nested outside the study area in this habitat and species frequently observed but not definitely known to breed in the habitat. The figures for the average number of pairs is derived from the populations in the study areas and augmented by data from observations in the same habitat but outside the study area.

The Stream Bottom Community

Vegetative Composition

The stream bottom community study area consisted of a 32-acre plot along Panther Branch in Sections 4 and 5, Range 25 East, Township 3 South. The area averaged 130 yards wide with the stream bed in the center and the outer boundaries more or less paralleling the stream bed. Sufficient width was allowed between these outer boundaries and the slopes to avoid edge effect.

The closure of the forest cover ranged from 50% to 75% and was generally uniform. The frequency of occurrence and basal area of the dominant and codominant trees is given in Table VI. The frequency of occurrence of the common lower story plants is given in Table VII. This community had the best ground cover of the three major habitats of the Preserve. Andropogon spp. formed about 75% of the non-woody ground cover. Panicum spp. and seedlings of the various woody species formed most of the remaining living ground cover. Heavy litter covered most of the space between plants so that very little bare ground was exposed.

TABLE V

Nesting Birds of the River Bottom Forests

Species	Pairs/100 A	Pairs/100 A	Average	Projected Estimate (200 acres)
	1961	1962		
Turkey Vulture	+	+	+	+
Wood Duck		1	1	1.0
Red-shouldered Hawk	1	1	1	2.0
Bobwhite	+			+
Turkey	+	+		+
Yellow-billed Cuckoo	5.7	5.7	5.7	11.4
Barred Owl	8.6	2.9	5.7	11.4
Chuck-will's-widow	8.6	2.9	5.7	11.4
Chimney Swift	+	+		+
Ruby-throated Hummingbird	2.9		2.9	5.8
Belted Kingfisher	+	+		+
Pileated Woodpecker	2.9	2.9	2.9	5.8
Red-bellied Woodpecker	5.7	5.7	5.7	11.4
Hairy Woodpecker	5.7	2.9	4.3	8.6
Downy Woodpecker	2.9	2.9	2.9	5.8
Great Crested Flycatcher	8.6	2.9	5.8	11.6
Acadian Flycatcher	14.3	11.4	12.9	25.8
Eastern Wood Pewee	5.7	5.7	5.7	11.4
Blue Jay	+	+		+
Crow	1	1	1	2.0
Carolina Chickadee	11.4	11.4	11.4	22.8
Tufted Titmouse	5.7	8.6	7.2	14.4
White-breasted Nuthatch	8.6	2.9	5.7	11.4
Carolina Wren	8.6	8.6	8.6	17.2
Wood Thrush	2.9	2.9	2.9	5.8
Blue-gray Gnatcatcher	11.4	2.9	7.2	14.4
White-eyed Vireo	25.7	17.1	21.4	42.8
Red-eyed Vireo	28.5	25.7	27.1	54.2
Black-and-White Warbler	8.6	8.6	8.6	17.2
Prothonotary Warbler	1	1	1	2.0
Swainson's Warbler	1	1	1	2.0
Worm-eating Warbler	3	2	2.5	5.0
Parula Warbler	8.6	11.4	10.0	20.0
Cerulean Warbler	2.9	2.9	2.9	5.8
Ovenbird	5.7	2.9	4.3	8.6
Louisiana Waterthrush	8.6	8.6	8.6	17.2
Kentucky Warbler	11.4	8.6	10.0	20.0
Yellow-breasted Chat	2	2	2	4.0
Hooded Warbler	14.3	17.1	15.7	31.4
American Redstart	20.0	14.3	17.2	34.4
Cardinal	8.6	5.7	7.2	14.4
Indigo Bunting	2.9	2.9	2.9	4.8
TOTALS (36 species, +6)	279	219	248	502

TABLE VI

Dominants and Codominants of the Stream Bottom Forest

<u>Species</u>	<u>Frequency of Occurrence (%)</u>	<u>Basal Area (sq.ft.)</u>	<u>(%)</u>
White Oak, <u>Quercus alba</u> L.	17	11.0	14.1
Shortleaf pine, <u>Pinus echinata</u> Mill.	17	23.1	29.6
Mocknut Hickory, <u>Carya tomentosa</u> Nutt.	16	11.4	14.6
Sweetgum, <u>Liquidambar styraciflua</u> L.	14	13.0	16.7
Ironwood, <u>Carpinus caroliniana</u> Walt.	7	2.7	3.4
Sourgum, <u>Nyssa sylvatica</u> Marsh.	6	4.9	6.3
Red Oak, <u>Quercus rubra</u> L.	4	2.8	3.6
Red Maple, <u>Acer rubrum</u> L.	4	1.2	1.6
Hornbeam, <u>Ostrya virginiana</u> (Mill.) K. Koch	4	.7	.9
Swamp Oak, <u>Quercus bicolor</u> Willd.	2	.7	.9
Pignut Hickory, <u>Carya glabra</u> (Mill.) Sweet	2	1.0	1.3
Winged Elm, <u>Ulmus alata</u> Michx.	2	1.5	1.9
Sycamore, <u>Platanus occidentalis</u> L.	2	2.9	3.7
Red Mulberry, <u>Morus rubra</u> L.	2	1.0	1.3
Ash, <u>Fraxinus</u> sp.	2	.6	.7
Red Cedar, <u>Juniperus virginiana</u> L.	1	.5	.6
TOTAL		78.0	

TABLE VII

Lower Story Plants of the Stream Bottom Forest
(d.b.h. less than 4"; > 1 meter high)

<u>Species</u>	<u>Frequency of Occurrence (%)</u>
Ironwood, <u>Carpinus caroliniana</u> Walt.	31
Red Cedar, <u>Juniperus virginiana</u> L.	16
Sweetgum, <u>Liquidambar styraciflua</u> L.	11
Witch-hazel, <u>Hamamelis virginiana</u> L.	10
Flowering Dogwood, <u>Cornus florida</u> L.	9
Hornbeam, <u>Ostrya virginiana</u> (Mill.) K. Koch	7
Red Oak, <u>Quercus rubra</u> L.	3
White Oak, <u>Quercus alba</u> L.	3
Shortleaf pine, <u>Pinus echinata</u> Mill.	2
Sourgum, <u>Nyssa sylvatica</u> Marsh.	1
Mocknut Hickory, <u>Carya tomentosa</u> Nutt.	1
Common Spicebush, <u>Lindera benzoin</u> (L.) Blume	1
Winged Elm, <u>Ulmus alata</u> Michx.	1

Avian Populations

The nesting bird populations showed an intermediate species composition between those of the moist river bottom and the drier uplands. No birds were restricted to this habitat. The estimate of species in the study area and the projected estimate for the 1100 acres of this community in the Preserve are given in Table VIII.

The Upland Community

Vegetative Composition

The upland Oak-Pine community study area was located in Sections 2 and 11, Range 25 East, Township 3 South. The 30-acre area was along the section line on the east side of the given sections. Crown closure of this area was from 70% to 100%. The area is typical of the intermediate areas of the Preserve, that is, those with moderate slopes. Lindzey (1950) recognized four game types in the upland community. However, field observations showed no significant variations in the avian species distribution in these four types. Significant divergence of species composition did occur on White Oak and Little White Oak Mountains, but the remoteness of these areas made it impossible to adequately sample the bird populations there.

The frequency of occurrence and basal area of the dominant and codominant trees are given in Table IX. The frequency of occurrence of the common lower story plants is given in Table X. The ground cover varied from sparse Andropogon in the more open areas to exclusively pine needle and leaf litter in areas with dense crown cover.

TABLE VIII

Species	Nesting Birds of the Stream Bottom Forests		Average	Projected Estimate (1,100 acres)
	Pairs/100 A 1961	Pairs/100 A 1962		
Turkey Vulture	+	+	+	+
Broad-winged Hawk	3.1	+	1	11
Sparrow Hawk	+	3.1	1	11
Bobwhite	3.1	+	3.1	34
Yellow-billed Cuckoo	3.1	3.1	3.1	34
Screech Owl	3.1	+	1	11
Chuck-will's-widow	+	+	+	+
Chimney Swift	+	+	+	+
Ruby-throated Hummingbird	1		1	11
Pileated Woodpecker	1	1	1	11
Red-bellied Woodpecker		+		+
Hairy Woodpecker	3.1	3.1	3.1	34
Downy Woodpecker	3.1	3.1	3.1	34
Great Crested Flycatcher	3.1	3.1	3.1	34
Acadian Flycatcher	9.4	6.3	7.9	87
Eastern Wood Pewee	9.4	9.4	9.4	103
Blue Jay	6.3	3.1	4.7	52
Crow	+	+	+	+
Carolina Chickadee	12.5	9.4	10.5	116
Tufted Titmouse	3.1	6.3	4.7	52
White-breasted Nuthatch	6.3	6.3	6.3	69
Carolina Wren	9.4	9.4	9.4	103
Wood Thrush		+	+	+
Blue-gray Gnatcatcher	6.3	3.1	4.7	52
White-eyed Vireo	3.1	3.1	3.1	34
Red-eyed Vireo	18.8	18.8	18.8	207
Black-and-white Warbler	3.1	3.1	3.1	34
Parula Warbler	9.4	12.5	10.5	116
Pine Warbler	9.4	6.3	7.9	87
Ovenbird	3.1	3.1	3.1	34
Louisiana Waterthrush	3.1	6.3	4.7	52
Kentucky Warbler	3.1	+	3.1	34
Indigo Bunting	+	3.1	3.1	34
TOTALS (27 species, +6)	140	126	136	1,491

TABLE IX

Dominants and Codominants of the Upland Forests

<u>Species</u>	<u>Frequency of Occurrence (%)</u>	<u>Basal Area (sq.ft.)</u>	<u>(%)</u>
Shortleaf Pine, <u>Pinus echinata</u> Mill.	81	69.6	87.0
White Oak, <u>Quercus alba</u> L.	10	2.9	3.6
Post Oak, <u>Quercus stellata</u> Wang.	7	6.6	8.4
Blackjack Oak, <u>Quercus marilandica</u> Muench.	2	.2	.25
TOTAL		79.3	

TABLE X

Lower Story Plants of the Upland Forests
(d.b.h. less than 4"; > 1 m. high)

<u>Species</u>	<u>Frequency of Occurrence (%)</u>
Mocknut Hickory, <u>Carya tomentosa</u> Nutt.	29
Post Oak, <u>Quercus stellata</u> Wang.	20
Blackjack Oak, <u>Quercus marilandica</u> Muench.	14
Flowering Dogwood, <u>Cornus florida</u> L.	14
White Oak, <u>Quercus alba</u> L.	6
Shortleaf pine, <u>Pinus echinata</u> Mill.	3
Common Spicebush, <u>Lindera benzoin</u> (L.) Blume	2
Red Oak, <u>Quercus rubra</u> L.	2

Avian Populations

The virgin stands of mature short-leaf pine are the habitat of the Preserve's two most unique permanent avian residents, the Red-cockaded Woodpecker and the Brown-headed Nuthatch.

Nice (1931) reported Red-cockaded Woodpeckers in 1925. This species was not recorded from the state again until 1954 (Baumgartner 1954). The Red-cockaded Woodpeckers were limited in distribution in the Preserve to areas with stands of large mature pine--d.b.h. 15 inches or more. Nest trees which I was able to locate averaged 17 inches d.b.h. Their habit of scaling the bark from the living pine for two feet above and below the entrance of the nest cavity and of puncturing a series of small holes to allow the pine pitch to ooze to the surface allows the nests to be located easily. The only nesting record outside the Preserve for Oklahoma was reported in Robber's Cave State Park near Wilburton in 1961 (Baumgartner 1961).

The Brown-headed Nuthatch was observed in Pushmataha County in 1920 (Nice 1921) and was not recorded in Oklahoma again until 1953 (Baumgartner 1954). Tom Jessee reported this species nesting in a fence post on the Preserve on 11 March 1954 with young noted in late April.

Other species found in the upland habitat are considered typical for the region. The estimates of species in the study area and the projected estimate for the 12,000 acres of this community type are given in Table XI.

TABLE XI

Nesting Birds of the Upland Forests

Species	Pairs/100 A	Pairs/100 A	Average	Projected
	1961	1962		Estimate (12,000 Acres)
Turkey Vulture	+	+	+	+
Sparrow Hawk	1	1	1	20
Bobwhite		+		+
Turkey	+	+	+	+
Yellow-billed Cuckoo	6.6	6.6	6.6	792
Roadrunner	+	+	+	4
Screech Owl	+	+	+	+
Chuck-will's-widow		+	+	+
Chimney Swift	+	+	+	+
Yellow-shafted Flicker		+		+
Red-bellied Woodpecker	3.3	3.3	3.3	396
Red-headed Woodpecker	6.6	6.6	6.6	792
Hairy Woodpecker	3.3	+	3.3	396
Downy Woodpecker	+	3.3	3.3	396
Red-cockaded Woodpecker	+	+	+	7-10
Great Crested Flycatcher	6.6	6.6	6.6	792
Eastern Wood Pewee	9.9	9.9	9.9	1188
Blue Jay	3.3	6.6	5.0	600
Crow	+	+	+	+
Carolina Chickadee	6.6	6.6	6.6	792
Tufted Titmouse	6.6	6.6	6.6	792
White-breasted Nuthatch	9.9	6.6	8.3	996
Brown-headed Nuthatch	+	+	+	+
Carolina Wren	3.3	6.6	5.0	600
Wood Thrush	+	6.6	6.6	792
Blue-gray Gnatcatcher	3.3	6.6	5.0	600
Red-eyed Vireo	9.9	19.9	14.5	1740
Black-and-white Warbler	3.3	+	3.3	396
Parula Warbler	+	+	+	+
Yellow-throated Warbler	+	+	+	+
Pine Warbler	9.9	13.2	11.5	1380
Prairie Warbler	+			+
Ovenbird	3.3	3.3	3.3	396
Scarlet Tanager	3.3	3.3	3.3	396
Summer Tanager	3.3	6.6	5.0	600
Indigo Bunting	3.3	+	3.3	396
Chipping Sparrow	+	+	+	+
TOTAL (35 species, +2)	107	130	128	15,262

CHAPTER V

ANNOTATED LIST OF SPECIES

In each account below information is given concerning the status, habitat, and specific role for each species from field notes compiled in the Preserve.

Ardea herodias Linnaeus: Great Blue Heron.

Post-nesting wanderer. First summer observations were on 18 June 1961 and 19 July 1962. Observed feeding along the river after these dates.

Florida caerulea (Linnaeus): Little Blue Heron.

Post-nesting wanderer. A single observation on 19 July 1962 of an immature bird feeding along the river.

Casmerodius albus (Linnaeus): Common Egret.

Post-nesting wanderer. No records during the summer of 1961. First recorded on 19 July 1962 and frequently observed along the river after this date.

Note: The weather had been very hot and dry from the last of June to 15 July 1962. Rains occurred the 15th, 16th, and 17th. The morning of the 19th was warm and there was a dense fog. I assume the weather change prompted the movement of these birds.

Anas discors Linnaeus: Blue-winged Teal.

Migrant. A small flock on Linson Creek and another on the river

were observed in the Preserve area on 27 August 1961.

Aix sponsa (Linnaeus): Wood Duck.

Nesting. One individual was seen in late June and four were seen on 6 July 1961. A pair in breeding plumage were seen examining a hole high in a sycamore tree near the river on 27 March 1962. Two were seen on 12 June and four were seen together from 15 June to 24 June in the same area. One of the four was an adult female and the others were immatures. The March record was the only time I observed the male during the summer of 1962.

Cathartes aura (Linnaeus): Turkey Vulture.

Nesting. This species was very common over the entire area. Nesting was probably completed before the first of June when my observations began. They have been reported to nest in rock slides in some of the sheltered ravines in the general area. Immature individuals were seen in mid-June. Groups of five to ten frequently roosted in the dead trees along the river.

Accipiter cooperi (Bonaparte): Cooper's Hawk.

Possible Nesting. Possible sight records in upland area on 16 and 23 June 1962, but these need substantiation. Body size and shape were correct for this species but, I was never able to get a good observation as the bird quickly disappeared in the dense cover.

Buteo lineatus (Gmelin): Red-shouldered Hawk.

Nesting. Adults were observed carrying food to nests during both summers. All nests were in the river bottom habitat although the adults commonly perched in the tall pines on hill tops along the river.

The exclusive use of this one habitat was attested by the fact that I had only one record of this form in upland habitat away from the river. Territories were estimated to be about one square mile and the two nest sites observed were 1.25 miles apart.

Buteo platypterus (Vieillot): Broad-winged Hawk.

Nesting. A nest located on 19 June 1961 was 40 feet in a mature short-leaf pine along Panther Branch. One adult was observed in the area and there were two downy young in the nest. The young were out of the nest on 28 June. This species was recorded along Panther Branch and North Linson Creek during 1962. An adult was observed on a nest in the river bottom area on 27 March 1964.

Falco sparverius Linnaeus: Sparrow Hawk.

Nesting. This species nested in upland habitat and was much more common along White Oak Mountain than in other areas of the Preserve. An adult female was observed feeding a large, fully-feathered young in a nest hole in a dead pine 20 July 1961. Family groups of 3 and 4 were noted along White Oak Mountain 19 June 1962.

Colinus virginianus (Linnaeus): Bobwhite.

Nesting. Frequently observed in the river bottom in 1961; one nest was located in the stream bottom habitat 10 July 1961 with four eggs. Family groups were observed in the stream bottom from 29 June to 5 July 1962 and family groups were noted in upland type during both summers. The nest in the stream bottom was located in a clump of Andropogon sp. in a brushy opening of the woodland along Panther Branch.

Meleagris gallopavo Linnaeus: Turkey.

Nesting. A hen and 3 poult were observed in the river bottom

6 July 1961; also other family groups were noted along Linson Creek in late summer of both years. No nests were found and I had very few upland observations.

Tringa solitaria Wilson: Solitary Sandpiper.

Migrant. One individual was seen 18 July 1961 along the river and was seen there regularly the remainder of the month.

Coccyzus americanus (Linnaeus): Yellow-billed Cuckoo.

Nesting. This species was found in all habitats of the Preserve. A nest with two eggs was located 1 July 1961 in the river bottom about 10 feet high in a small elm. The nest had a bulky stick and leaf base lined with a mat of the tree lichen Usnea. Another nest with one egg and one newly hatched young was located in the river bottom 19 July 1962. A third nest containing two eggs was found in a small flowering dogwood in an upland site along Barn Branch 26 June 1962.

Geococcyx californianus (Lesson): Roadrunner.

Nesting. I had observations of single individuals in upland areas during both summers. An adult and three young were seen 17 June 1962 on Pine Mountain.

Otus asio (Linnaeus): Screech Owl.

Nesting. This species was observed along Panther Branch and in the upland association. Probably nested during both summers in an area of very dense second-growth pines at a chimney in the old CCC camp site; a group of three was observed regularly from 26 June 1961 to early August and also, from 4 July 1962 to the end of the month. Although this area was less than one-half mile from my quarters, I rarely heard these owls at night. All individuals were of the red color phase.

Strix varia Barton: Barred Owl.

Nesting. This species was frequently heard in the evening along the river bottom during both summers, although I have but one sight record on 5 July 1961 of an adult.

Caprimulgus carolinensis Gmelin: Chuck-will's-widow.

Nesting. Found commonly in the drier areas of the levee area of the river bottom and most often heard from this area. A nest with 2 eggs was located on 8 June 1962 in upland type area on forest floor in litter. An adult and two young just able to fly were found in the mature pine upland near the headquarters buildings on 1 July 1962.

Caprimulgus vociferus Wilson: Whip-poor-will.

Post-nesting wanderer (?). One individual was heard at 8:15 p.m. 21 July 1961 about 3 miles east of the Preserve. I have no other records for this form and although this was outside the Preserve, I have included this record because of the lack of information concerning this form in eastern Oklahoma.

Chaetura pelagica (Linnaeus): Chimney Swift.

Nesting. Seen commonly over the river and ravines of the Preserve. Undoubtedly some of these nest in natural situations, however, the only roosting and nesting site I was able to locate was the chimney of the manager's home.

Archilochus colubris (Linnaeus): Ruby-throated Hummingbird.

Nesting. Found along the river bottom and creeks. Distribution and abundance is probably regulated by the distribution of trumpet vine (Campsis radicans) and horsemint (Monarda sp.).

Megaceryle alcyon (Linnaeus): Belted Kingfisher.

Feeding visitant; possible nesting. A pair fed regularly during both summers along the river and rested at the mouth of Barn Branch. I believe that these birds nested outside the Preserve.

Colaptes auratus (Linnaeus): Yellow-shafted Flicker.

Nesting. I had no record during the summer of 1961. A pair was found regularly in a area of large dead pines with Red-headed Woodpeckers and Sparrow Hawks during the summer of 1962. An individual was seen along Linson Creek in mid-July 1962.

Dryocopus pileatus (Linnaeus): Pileated Woodpecker.

Nesting. I found one nest hole in the river bottom habitat in a large sycamore near a shallow sink hole. The nest opening was about 30 feet high. These birds were generally seen working through the woodlands in pairs. They constantly called while working. The area covered by a pair was probably slightly more than a square mile.

Centurus carolinus (Linnaeus): Red-bellied Woodpecker.

Nesting. One pair nested in a dead snag along the river bottom in June of both years and remained in the same area during the entire study periods. This species was frequently observed in the stream bottom and upland habitats, also.

Melanerpes erythrocephalus (Linnaeus): Red-headed Woodpecker,

Nesting. Found nesting only in areas of upland habitat with several large dead snags; thus, the distribution was concentrated in small areas over the Preserve.

Dendrocopos villosus (Linnaeus): Hairy Woodpecker.

Nesting. Found most frequently in the river bottom habitat. The populations of Hairy and Downy Woodpeckers were about equal in the Preserve. Family groups were noted up to 5 July 1962.

Dendrocopos pubescens (Linnaeus): Downy Woodpecker.

Nesting. The nesting of both the Downy and Hairy Woodpecker was probably completed before the field study began; however, family groups of D. pubescens were found until mid-June during both summers.

Dendrocopos borealis (Vieillot): Red-cockaded Woodpecker.

Nesting. Nest holes were observed in several of the large, mature pines (d.b.h. 15+ inches) along the upland study area and also along the North Linson Creek area. As the nest trees are rather easy to spot, I feel these were about the only concentrations in the Preserve. I doubt if there were more than 10 pair of active nesting birds in the Preserve; my actual count was 7 pair.

Myiarchus crinitus (Linnaeus): Great Crested Flycatcher.

Nesting. Seemed to prefer the ridge woodlands with mixed post oak, blackjack oak, white oak, and shortleaf pine to the areas where the shortleaf pines were in greater dominance. The greater abundance of nesting cavities in the mixed oak woodlands was an important factor in their distribution within the Preserve.

Empidonax virescens (Vieillot): Acadian Flycatcher.

Nesting. One of the more common species along the river bottom and stream bottoms. Observed feeding young in early June.

Contopus virens (Linnaeus): Eastern Wood Pewee.

Nesting. Found locally along the river bottom and larger creeks with a more even distribution in the upland. Observed feeding young in mid-June during both summers. One nest containing two young was located along Barn Branch 8 June 1962 about 12 feet from the ground in a small American holly.

Cyanocitta cristata (Linnaeus): Blue Jay.

Nesting. Population showed about equal densities in stream bottoms and uplands. The population within the Preserve appeared to be relatively low compared to that found in the more open areas outside the Preserve.

Corvus brachyrhynchos Brehm: Common Crow.

Nesting. A family group ranged over the river bottom during both summers. Frequently observed in other habitats.

Parus carolinensis Audubon: Carolina Chickadee.

Nesting. Common inhabitant in all habitats. Family groups of from 3 to 7 were noted up to late July of both summers. No young birds just out of the nest, or any nests, were ever located even in early June. Nesting was completed by late May and the family groups remained together throughout the first summer, at least until early August.

Parus bicolor Linnaeus: Tufted Titmouse.

Nesting. About equally distributed over all habitats of the Preserve. Nesting activities more conspicuous during June; birds became quiet by mid-July.

Sitta carolinensis Latham: White-breasted Nuthatch.

Nesting. Appears to be about equally common in all woodland habitats. Nesting was probably completed prior to June.

Sitta pusilla Latham: Brown-headed Nuthatch.

Nesting. Nesting was completed well before the first of June. A single individual was observed near the main gate in upland mature pine on 24 June 1961. A group of three was observed in late August in the mature pines on the ridge at the cross-roads north of the Field Cabin. During June and July 1962 a family group was seen and heard regularly in the mature pines in the Turkey Pen area. This form was always observed in the crown cover of the mature pines.

Thryothorus ludovicianus (Latham): Carolina Wren.

Nesting. This species was equally common in the river bottom and ravines; found in upland habitats about half as frequently. Family groups ranged in size of three to seven, with the average of about four. Commonly found near drift piles, thickets, and rocky ledges. Foraged on the ground and in the undergrowth in all habitats.

Hylocichla mustelina (Gmelin): Wood Thrush.

Nesting. Rarely seen, but frequently heard both summers in dense undergrowth of river bottom; in 1962 noted in ravines; common in uplands in summer of 1962. Most of my upland observations were from areas with an abundance of oaks; fewer were noted in areas of pure pine. I cannot explain the absence of this species in the uplands during the summer of 1961.

Polioptila caerulea (Linnaeus): Blue-gray Gnatcatcher.

Nesting. Most common in summer of 1961 in the river bottom.

Populations about equal in all types in 1962. Appear to favor crown cover of woodlands, especially the dense edge near the river. One damaged nest was found at the base of a tall cypress in a gravel bar in the river. This species was very common on White Oak Mountain.

Vireo griseus (Boddaert): White-eyed Vireo.

Nesting. An abundant summer bird along the river bottom; lesser numbers found along the creeks. No records for uplands except for post-nesting birds seen in late August.

Vireo olivaceus (Linnaeus): Red-eyed Vireo.

Nesting. The most abundant breeding bird in the Preserve. Found in all habitats in larger breeding populations than any other form.

Mniotilta varia (Linnaeus): Black-and-white Warbler.

Nesting. Most commonly found in the river bottom during June and July and less frequently along the ravines. Rather common in upland areas in late August. Forages in mid-branches.

Protonotaria citrea (Boddaert): Prothonotary Warbler.

Nesting. Rare along Mountain Fork River within the Preserve. The rapid rises which normally occur along the river removes most of the dead snags which would serve as nest sites. I have notes on a family group of four on 6 July 1961. Single singing males were seen in mid-June of both summers.

Limnothlypis swainsonii (Audubon): Swainson's Warbler.

Nesting; rare. An adult was observed feeding one young on 26 July 1961 on the ground in the cane thickets of the river bottom. A pair of adults was seen in the undergrowth near the same location on 30 June 1962.

Helmitheros vermivorus (Gmelin): Worm-eating Warbler.

Nesting; rare. A pair of adults was observed feeding one young in an area of dense undergrowth of the river bottom on 5 July 1961. A pair of adults was observed feeding and carrying food in the same area from 24 June to mid-July 1962. This species was also observed along Hee Creek on 20 July 1962, but this record is not considered a nesting individual due to the late date.

Parula americana (Linnaeus): Parula Warbler.

Nesting. Found in equal numbers along the river bottom and the ravines; observed less frequently in upland areas. One nest with four young was found on 9 July 1962 in pendant arboreal lichens about eight feet from the ground in a small flowering dogwood tree in an upland situation. The nest was collected after the young left it 17 July. Only lichens were used in constructing the nest and little evidence that the mass contained a nest could be observed except by very close inspection.

Dendroica cerulea (Wilson): Cerulean Warbler.

Nesting; rare. During the summer of 1961, at least three pairs were nesting in the 35-acre river bottom study area. These were observed from early June to the last of June. From mid-June to the last of June, the adults were feeding young. I had no further observations until late August when adults in bright plumage were noted in upland habitat near the river bottom area. The single observation during 1962 was in late June when an adult and one young were seen in the river bottom area. Generally, observations were from the mid-branches in the dense edge of the river bottom near the river.

Dendroica dominica (Linnaeus): Yellow-throated Warbler.

Probable nesting; summer status uncertain. The few observations I have of this species are: 19 July 1961, one adult in upland habitat in a large oak; 27 August 1961, three solitary adults along Panther Creek in an oak-pine area; 9 June 1962, one adult in upland habitat in a mature pine stand; 14 June 1962, two solitary adults in upland habitat in mature oaks; 24 June 1962, one adult in upland mature pine stand; 28, 29 March 1963, several solitary adults in upland mature oak-pine stands. All records are of foraging birds in crown cover. It seems probable that this form had completed nesting prior to early June when I started my studies.

Dendroica pinus (Wilson): Pine Warbler.

Nesting. Common in upland areas and found about half as frequently in the ravine habitat. Adults were commonly seen feeding young through June and to mid-July. This warbler generally forages in the crown cover of the mature pines.

Dendroica discolor (Vieillot): Prairie Warbler.

Status uncertain. A pair of adults was observed on 24 June 1961 carrying food into a dense tangle of greenbrier and second-growth oaks along the road at the main gate. A singing male was observed in similar habitat near the gate north of Barn Branch from 25 June to 3 July 1961.

Seiurus aurocapillus (Linnaeus): Ovenbird.

Nesting. This species was observed in about equal numbers in the dryer parts of the river bottom, ravines, and in the brushy areas of the uplands. No nests were found, but several observations were made of adults carrying food to young out of the nest. Generally recorded on the ground or in lower levels of sparse undergrowth.

Seiurus motacilla (Vieillot): Louisiana Waterthrush.

Nesting. A common nesting bird along the river, with about half the nesting density along the same dense understory habitat of the creeks. Young were out of the nest in early June in both summers. Family groups seemed to maintain feeding territories into late July. Foraged along stream banks and on floor of the river bottom forests.

Oporornis formosus (Wilson): Kentucky Warbler.

Nesting. Common in undergrowth of the river bottom during both summers; records in ravine habitat in summer of 1961. Young and adults together from early June to mid-July.

Icteria virens (Linnaeus): Yellow-breasted Chat.

Probably nesting. Two pairs were located each summer in the dense cane thickets near the north fence of the river bottom study area. The birds stayed in the same areas from early June to late July. Observed only in this dense undergrowth in the Preserve; however, I have upland observations in McCurtain County outside the Preserve.

Wilsonia citrina (Boddaert): Hooded Warbler.

Nesting. A common nesting bird in areas of the river bottom with dense undergrowth. Populations about the same during both summers. Song and feeding activity suggest two broods; with the first nesting ending in mid-June and a second nesting period reaching a peak in early July. Foraged in the dense cane; sang from low shrubs and cane--only rarely observed as high as the mid-branches of the understory trees.

Setophaga ruticilla (Linnaeus): American Redstart.

Nesting. Probably a first nesting is completed by early June and a second brood is off by mid-July. A common bird in the river bottom;

generally ranges in the mid-branches and crown cover, moving quickly from one spot to another. No observations of this form in any other habitat type.

Piranga olivacea (Gmelin): Scarlet Tanager.

Nesting. Nested in small numbers in the uplands--more commonly found in areas of mature pines. Males may be singing in crown cover or mid-branches of the pines. Family groups observed in mid-June. Two nests: ten feet from ground on horizontal branch of young pine, with two young on 3 July 1960; and, thirty feet from ground on horizontal branch in mature pine with female on nest and male in area on 8 June 1962.

Piranga rubra (Linnaeus): Summer Tanager.

Nesting. A nesting bird of the upland crown cover and mid-branches. During the summer of 1961 the two populations of tanagers were about equal; in 1962 the Summer Tanagers were more frequently observed (about two to one) than the Scarlet Tanagers. Family groups observed in mid-June to early July.

Richmondia cardinalis (Linnaeus): Cardinal.

Nesting. Commonly observed in mid-branches and undergrowth of the river bottom habitat. One nest with three eggs located on 18 June 1961; family groups observed from mid-June to early July. A female was carrying sticks to a nest site in the river bottom area on 11 July 1962, but no later observations of activity at the site were made.

Passerina cyanea (Linnaeus): Indigo Bunting.

Nesting. Commonly observed in the undergrowth in the river bottom; one nest found on 11 July 1961 with three eggs was about seven feet from the ground in an open area with tall, dense cover. This was

probably a second-nesting as family groups were observed in mid-June during both summers. Also found in upland and ravine areas where it frequented the mid-branches and undergrowth. From my limited observations, this appeared to be a common species on White Oak Mountain.

Spizella passerina (Bechstein): Chipping Sparrow.

Nesting. In the Preserve, this species was found in the more open areas of the uplands. Foraged on the ground and in the undergrowth; frequently seen singing from mid-branches of pine and oak trees. Much more common in the more open areas outside the Preserve.

CHAPTER VI

DISCUSSION AND CONCLUSION

Field studies of the summer nesting birds of the McCurtain Game Preserve were conducted during the summers of 1961 and 1962 in the months of June, July and early August. Intensive studies were made in three areas representative of the major habitats of the Preserve. Data derived from these study areas were augmented by less intensive surveys within each of the habitats at various locations over the Preserve. The populations of the summer nesting birds of the three major habitats are summarized in Tables V, VIII, and XI.

A summary of the three habitats, the relative number of species per habitat, and projected numbers of pairs per habitat within the Preserve are given in Table XII.

TABLE XII

Comparison of Nesting Bird Populations in the
Major Habitats of the McCurtain Game Preserve, 1961-1962

<u>Habit</u>	<u>Total Area</u>	<u>Number of Species</u>	<u>Average Number of Pairs/100 Acres</u>	<u>Projected Estimate</u>
River Bottom	200 Acres	36 (+6 possible)	248	502
Stream Bottom	1,100 "	27 (+6 ")	136	1,491
Upland	12,000 "	35 (+2 ")	128	15,262
TOTALS	13,300 Acres	56 species		17,255

Eleven species were nesting only in the River Bottom habitat within the Preserve. These species were the Wood Duck, Red-shouldered Hawk, Barred Owl, Prothonotary Warbler, Swainson's Warbler, Worm-eating Warbler, Cerulean Warbler, Yellow-breasted Chat, Hooded Warbler, American Redstart, and Cardinal.

No species were found using the Stream Bottom habitat exclusively for nesting. However, seven species were limited to the Stream Bottom and the River Bottom--the more moist habitats within the Preserve. These were the Broad-winged Hawk, Ruby-throated Hummingbird, Belted Kingfisher, Acadian Flycatcher, Black-and-white Warbler, Louisiana Waterthrush, and Kentucky Warbler.

A total of eighteen species were limited to the two riparian woodland formations within the Preserve--the River Bottom and the Stream Bottom communities. Of these eighteen species, seven are approaching their western limits of distribution (A.O.U. 1957). The Wood Duck, Prothonotary Warbler, Louisiana Waterthrush, Swainson's Warbler, and Cerulean Warbler are typical nesting species of the riparian habitats over their entire breeding ranges. The Ovenbird and the Worm-eating Warbler are typical woodland nesting forms over most of their range and are restricted to the riparian woodlands only in the southwestern limits of their nesting distribution (A.O.U. 1957).

Four species were limited to the Stream Bottom and Upland Forests for their nesting activities within the Preserve. These were the Sparrow Hawk, Screech Owl, Yellow-shafted Flicker, and Pine Warbler.

The intermediate character of the Stream Bottom communities was therefore emphasized by the nesting distribution pattern which showed an overlap of species from both the River Bottom and the Upland Forests, as well as, a mixed floral composition (Tables III, IV, VI, VII, IX, X).

The Upland habitat was utilized by seven species exclusively for their nesting activities. These were the Roadrunner, Red-headed Woodpecker, Red-cockaded Woodpecker, Brown-headed Nuthatch, Prairie Warbler, Scarlet Tanager, Summer Tanager, and Chipping Sparrow.

Twenty-three species utilized all three of the major habitats in the Preserve for nesting activities. These were the Turkey Vulture, Bobwhite, Turkey, Yellow-billed Cuckoo, Chuck-will's-widow, Chimney Swift, Red-bellied Woodpecker, Hairy Woodpecker, Downy Woodpecker, Great Crested Flycatcher, Eastern Wood Pewee, Blue Jay, Crow, Carolina Chickadee, Tufted Titmouse, White-breasted Nuthatch, Carolina Wren, Wood Thrush, Blue-gray Gnatcatcher, White-eyed Vireo, Red-eyed Vireo, Ovenbird, and Indigo Bunting. This pointed out the fact that a woodland habitat--regardless of its composition--was the only requirement for certain species with less specialized nesting niches. It was also noted that some of these species reached greater densities in one habitat than in the others.

The most abundant species in the Preserve was the Red-eyed Vireo having had a total projected estimate of about 2,000 pairs for the 13,300 acres or an average of 15+ pairs per 100 acres for the entire Preserve. This figure is almost twice that of the next most abundant species. Other conspicuously numerous species and their total projected estimates were the Pine Warbler (1,467), Eastern Wood Pewee (1,203), White-breasted Nuthatch (1,076), Tufted Titmouse (858), Great Crested Flycatcher (838), Yellow-billed Cuckoo (837), and Carolina Chickadee (831). Except for the Pine Warbler, all of these species utilized all three habitats for nesting. The population of Pine Warblers was high in the extensive upland forests seemingly lacking competition from other species.

Nine species were considered to be rare within the Preserve. The following reasons are suggested to explain the limited occurrence of these nine species: The Wood Duck and Prothonotary Warbler populations were limited due to the lack of proper nesting cavities in trees along the river; the minimal numbers of Red-shouldered Hawks are attributed to their large territorial requirements and the limited area of suitable river bottom habitat; the Roadrunner, having recently invaded this region (Lowery 1955), is reaching its eastern limits of distribution (A.O.U. 1957); the Red-cockaded Woodpecker, being intimately associated with mature stands of pines, is limited by their distribution; the Brown-headed Nuthatch, Prothonotary Warbler, Swainson's Warbler, Worm-eating Warbler, and Cerulean Warbler are approaching the western limits of their nesting range (Griscom and Sprunt 1957); and the Turkey populations, once extirpated from this area, have been reintroduced.

The densities of a few species within the Preserve were lower than those outside of the Preserve. Among these, personal observations implied that the Chipping Sparrow, Bobwhite, Cardinal, Blue Jay and Crow were more tolerant of the open areas created by the activities of man.

Although common outside, the Mourning Dove, House Sparrow, Orchard Oriole, Brown-headed Cowbird, Eastern Bluebird, and Starling were found only in limited numbers in the small disturbed areas around the manager's home and barns. These species were never recorded in any other part of the Preserve.

Major findings and conclusions of this study include:

1. Of the three habitats in the Preserve, the river bottom supported the highest population of nesting birds (248 pairs per 100 acres) and the highest number of species (36 plus six others possible).

2. The stream bottom habitat showed characteristics intermediate between the moist river bottom and the drier upland in both vegetative and avian composition.
3. The population of ground nesting species was suppressed by the destruction of the ground cover, nests, and young by the activities of swine.
4. The mature virgin stands of shortleaf pine were utilized by the Red-cockaded Woodpecker and the Brown-headed Nuthatch. These species were not found in the cut-over areas surrounding the Preserve.
5. For the first time, nesting activities of the Swainson's Warbler and Worm-eating Warbler were recorded for McCurtain County.

LITERATURE CITED

- American Ornithologists' Union. 1957. 5th ed. Check-list of North American birds. Baltimore, Maryland. 691 pp.
- Baumgartner, F. M. 1954. Winter season for Southern Great Plains Region. Audubon Field Notes 8: 260.
- _____. 1961. Nesting season for Southern Great Plains Region. Audubon Field Notes 15: 478.
- Beecher, W. J. 1942. Nesting birds and the vegetation substrate. Chicago Ornith. Soc., Chicago. 60 pp.
- Clements, F. E., and V. E. Shelford. 1939. Bio-ecology. John Wiley and Sons, N. Y. 425 pp.
- Cooke, M. T. 1927. The purpose of bird censuses and how to take them. U. S. Dept. Agr. Circ. 261: 1-4.
- Dice, L. R. 1943. The biotic provinces of North America. U. of Mich. Press, Ann Arbor. 78 pp.
- Duck, L. G., and J. B. Fletcher. 1943. A game type map of Oklahoma. Division of Wildlife Restoration, Okla. Game and Fish Dept., Okla. City.
- _____. 1944. A survey of the game and furbearing animals of Oklahoma. Okla. Game and Fish Comm., Pittman-Robertson Ser. 2, Bull. 3, 144 pp.
- Gray, F., and H. M. Galloway. 1959. Soils of Oklahoma. Okla. State Univ. Exp. Station Misc. Publ. 56. 65 pp.
- Griscom, L. and A. Sprunt, Jr. The warblers of America. Devin-Adair Co., New York. 356 pp.
- Kalala, O. 1938. Über die regionale Verteilung der Brutvogelfauna im Flussgebiet des Kokemäenjoki. Annales Zoologici Soc. Zool.-Bot. Fennicae Vanamo 5: 1-291.
- Kendeigh, S. C. 1941a. Birds of a prairie community. Condor 43: 165-174.
- _____. 1941b. Territorial and mating behavior of the house wren. Ill. Biol. Mono. 18: 1-120.
- _____. 1944. Measurement of bird populations. Ecol. Monogr. 14: 67-106.
- Grosvenor, G. H. 1916. The world's record for density of bird population. Bird-Lore 18: 77.

- Harlan, J. R. undated. Grasslands of Oklahoma. Okla. State Univ. Agronomy Dept. mimeo. 160 pp.
- Hicks, L. E. 1925. A ten-year study of a bird population in central Ohio. *Amer. Midl. Nat.* 16: 177-186.
- Honess, C. W. 1923. Geology of the Southern Ouachita Mountains of Oklahoma. Okla. Geological Survey, Bull. 32, Part I, 278 pp., Part II, 76 pp.
- Lack, D. 1935. The breeding bird population of British heaths and moorland. *Journ. Animal Ecol.* 4: 43-57.
- Lindzey, J. S. 1950. The white-tailed deer in Oklahoma. Okla. Game and Fish Dept., Oklahoma City. 105 pp.
- Lowery, G. H., Jr. 1955. Louisiana birds. Louisiana State University Press, Baton Rouge, Louisiana. 556 pp.
- Lutz, H. J. 1930. The vegetation of Heart's Content, a virgin forest in northwestern Pennsylvania. *Ecology* 11: 1-29.
- Nice, M. M. 1921. The brown-headed nuthatch in Oklahoma. *Condor* 23: 131.
- _____. 1927. Seasonal fluctuations in bird life in central Oklahoma. *Condor* 29: 144-149.
- _____. 1931. The birds of Oklahoma. rev. ed. Univ. of Okla. Biol. Survey 3: 1-224.
- _____. 1941. The role of territory in bird life. *Amer. Midl. Nat.* 26: 441-487.
- Palmgren, P. 1930. Quantitative undersøchungen über die vogelfauna in den Wäldren Südfinlands mit besonderer Berücksichtigung Alands. *Acta Zoologica Fennica* 7: 1-219. (Not seen, reviewed in Kendeigh, 1944).
- _____. 1931. Einige quantitative Vogelbestandaufnahmen aus Muonio, Lappland. *Ornis Fennica* 3-4: 73-84. (Not seen, reviewed in Kendeigh, 1944).
- Pitelka, F. A. 1941. Distribution of birds in relation to major biotic communities. *Am. Midl. Nat.* 25: 113-137.
- _____. 1942. High population of breeding birds within an artificial habitat. *Ecology* 44: 172-174.
- Pitt, W. D., and C. B. Spradlin. 1963. Geology of Beavers Bend State Park. *in* Beavers Bend State Park. Okla. Geological Survey Guide Book XI. 46 pp.
- Saunders, A. A. 1938. Studies of breeding birds in the Allegany State Park. N. Y. State Mus. Bull. 318: 1-160.

- Schiermann, G. 1930. Studien über siedelungsdichte im Brutgebiet. Journ. für Ornith. 78: 137-180. (Not seen, reviewed in Kendeigh, 1944).
- _____. 1934. Studien über Siedlungsdichte im Brutgebiet. II. Der brandenburgische Kiefernwald. Journ. für Ornith. 82: 455-486. (Not seen, reviewed in Kendeigh, 1944).
- Shelford, V. E. 1926. Naturalist's guide to the Americas. Williams and Wilkins Co., Baltimore. 761 pp.
- _____. 1963. The ecology of North America. Univ. of Ill. Press, Urbana, Ill. 576 pp.
- Tuovinen, A. 1936. The bird population of the island Nesterinsaari in the summer of 1934 and 1935. Ornis Fennica 13: 137-139.
- U. S. Dept. of Agri. 1941. Climate and man. U. S. Gov't. Printing Office, Washington, D. C. 1248 pp.
- U. S. Dept. of Agri. 1949. Trees. U. S. Gov't. Printing Office, Washington, D. C. 944 pp.
- U. S. Dept. of Commerce. 1954-1963. Climatological Data. Oklahoma Sections. U. S. Gov't Printing Office, Washington, D. C.
- Weaver, J. E., and F. E. Clements. 1929. Plant ecology. McGraw-Hill, N. Y. 520 pp.
- Wheeler, P. R. 1961. letter to author dated 29 November 1961.
- Whitaker, J. R. 1916. A record bird census. Bird-Lore 18: 248-249.
- Williams, A. B. 1936. The composition and dynamics of a beech-maple climax community. Ecol. Mono. 6: 317-408.
- Zimmerman, R. 1932. Ueber quantitative bestandsaufnahmen in der Vogelwelt. Mitteil. des Vereins sächs. Ornithol. 3: 253-267. (Not seen, reviewed in Kendeigh, 1944).

VITA

William Alfred Carter

Candidate for the Degree of

Doctor of Philosophy

Thesis: ECOLOGY OF THE SUMMER NESTING BIRDS OF THE
McCURTAIN GAME PRESERVE.

Major Field: Zoology

Biographical:

Born: September 16, 1935 at Ada, Oklahoma.

Undergraduate Study: East Central State College, B. S. Ed.,
1957.

Graduate Study: Oklahoma State University, M.S., 1960.
Oklahoma State University, Ph. D., 1965.

Professional Experience: Science Instructor, Union High
School, Broken Arrow, Oklahoma, 1957-1959; Fellow,
National Science Foundation Academic Year Institute,
Oklahoma State University, 1959-1960; Graduate Teaching
Assistant, Oklahoma State University, 1960-1963; Fellow,
National Science Foundation, Summer 1961 and 1962;
Instructor, Department of Biology, Northwestern State
College, Alva, Oklahoma, 1963-1964; Assistant Professor,
Department of Biology, East Central State College, Ada,
Oklahoma, beginning September, 1964.

Organizations:

Honorary: Phi Sigma, Sigma Xi.

Professional: American Ornithologists' Union, Cooper
Ornithological Society, Herpetologists' League,
Oklahoma Academy of Science, Oklahoma Ornithological
Society, National Audubon Society, Southwestern
Association of Naturalists, Wilson Ornithological
Society.