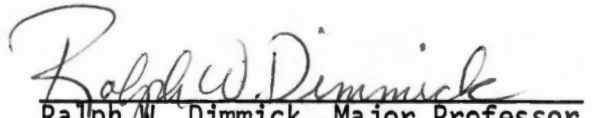
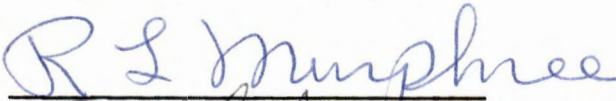
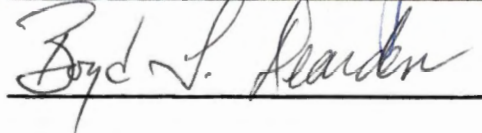


To the Graduate Council:

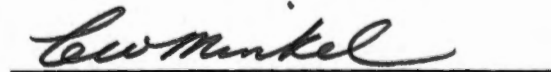
I am submitting herewith a thesis written by Elizabeth S. Stogsdill entitled "The Nesting Chronology of Mourning Doves in Knox County, Tennessee." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife and Fisheries Science.


Ralph W. Dimmick, Major Professor

We have read this thesis
and recommend its acceptance:

Accepted for the Council:


The Graduate School

THE NESTING CHRONOLOGY OF MOURNING DOVES
IN KNOX COUNTY, TENNESSEE

A Thesis
Presented for the
Master of Science
Degree
The University of Tennessee, Knoxville

Elizabeth S. Stogsdill

December 1983

ACKNOWLEDGMENTS

I would like to thank my major professor, Dr. Ralph W. Dimmick, for his assistance and friendship throughout this study. I also thank the members of my committee, Drs. Robert L. Murphree and Boyd L. Dearden, for their critical review of the manuscript.

Special thanks are extended to Rollie Reynolds for his assistance with the field work. I am especially grateful to my parents for their faith in me in all my endeavors. My deepest appreciation goes to my husband, Jim, for his continuous support and encouragement.

Funds for this project were provided by the Tennessee Wildlife Resources Agency through the Federal Aid to Wildlife Restoration Act and by The University of Tennessee Agricultural Experiment Station.

ABSTRACT

The nesting chronology of mourning doves (Zenaida macroura) was investigated on a rural area in Knox County, Tennessee from 1 February to 31 October, 1979 and 1980. The proportion of annual recruitment occurring after 1 September and regional ecology in terms of habitat, nesting distribution, and productivity were investigated. The first nests were initiated 24 March 1979 and 22 March 1980. Nest initiation peaked in April in 1979 and 1980. The last nests were initiated 3 August 1979 and 5 September 1980. The first young fledged the nest 22 April 1979 and 26 April 1980. The proportion of young recruited after 1 September varied widely between years. In 1979 no young were produced after 1 September. In 1980, 5 young (33.3%) were recruited after 1 September. Six nests (35.3%) were successful in fledging at least 1 young in 1979 and 10 nests (32.3%) were successful in 1980. Mourning doves made 2.8 nest attempts per pair in 1979 and 3.9 nest attempts per pair in 1980. The fledgling production was 0.6 young per nest attempt and 1.7 young per breeding pair in 1979. In 1980, production was 0.5 young per nest attempt and 1.9 young per breeding pair. Most nests (41.7%) were located in wooded fencerows.

TABLE OF CONTENTS

CHAPTER	PAGE
I. INTRODUCTION	1
II. DESCRIPTION OF STUDY AREA.	4
Location	4
Land Use and Vegetation.	4
Topography	8
Water Sources.	8
Climate.	9
III. METHODS.	11
Statistical Analysis	12
IV. RESULTS.	13
Nest Initiation.	13
Clutch Size and Hatching	15
Fledging	15
Duration of Nesting Season	18
Distribution of Nesting Effort	18
Nesting Success.	21
Nest Destruction	21
Production	23
Production per nest attempt.	23
Production per breeding pair	23
Production density	26
Nesting Habitat.	26
Nesting vegetation	26
Height of nests and dominant vegetation.	26
Secondary use of nests	30
V. DISCUSSION	31
Nesting Chronology	31
Initiation of nesting.	31
Monthly nesting activity	32
Monthly production	34
Duration of the nesting season	37
Nesting Success.	38
Success of eggs and nestlings.	38
Nest success	38
Production	39
Breeding population.	39
Breeding density	40
Productivity	41

CHAPTER	PAGE
V. (Continued)	
Nesting Habitat.	44
Habitat utilization.	44
Selection of nest sites.	44
VI. SUMMARY.	46
LITERATURE CITED	49
APPENDIX	53
VITA	55

LIST OF TABLES

TABLE		PAGE
1.	Distribution of Land Use Types on the Study Area in Knox County, Tennessee, 1979 and 1980	7
2.	Number of Eggs Hatched and Young Fledged Each Month on the Study Area in Knox County, Tennessee, 1979 and 1980.	16
3.	Causes of Nest Failure on the Study Area in Knox County, Tennessee, 1979 and 1980.	22
4.	Mourning Dove Production Per Breeding Pair on the Study Area in Knox County, Tennessee, 1979 and 1980	24
5.	Mourning Dove Production of Young Per 100 Eggs Laid and Per Nest Attempt on the Study Area in Knox County, Tennessee, 1979 and 1980.	24
6.	Nesting Success and Productivity on the Study Area in Knox County, Tennessee, 1979 and 1980	25
7.	Mourning Dove Nesting and Fledgling Density on the Study Area in Knox County, Tennessee, 1979 and 1980	27
8.	Habitat Types Used as Nesting Sites by Mourning Doves on the Study Area in Knox County, Tennessee, 1979 and 1980.	27
9.	Tree Species Used for Nest Sites by Mourning Doves on the Study Area in Knox County, Tennessee, 1979 and 1980.	28
10.	Height of Mourning Dove Nests and Height of Dominant Vegetation on the Study Area in Knox County, Tennessee, 1979 and 1980.	29

LIST OF FIGURES

FIGURE	PAGE
1. Map of Section 1 of the Study Area in Knox County, Tennessee.	5
2. Map of Section 2 of the Study Area in Knox County, Tennessee.	6
3. Total Number of Nests Initiated Each Month Between 1 February and 31 October on the Study Area in Knox County, Tennessee, 1979 and 1980	14
4. Cumulative Percentage of Eggs Hatched on the Study Area in Knox County, Tennessee.	17
5. Cumulative Percentage of Young Fledged on the Study Area in Knox County, Tennessee.	19
6. Total Number of Active Nests Each Month Between 1 February and 31 October on the Study Area in Knox County, Tennessee, 1979 and 1980	20

CHAPTER I

INTRODUCTION

The nesting chronology of the mourning dove (Zenaida macroura) is one of the most important aspects of its life history. Nesting and productivity research are currently receiving emphasis as an integral part of dove management. Gaining an understanding of the relationship between production potential and hunting regulations is a primary objective of dove productivity research.

Most of the early work on mourning doves involved various aspects of life history. Nice (1922, 1923) published one of the first modern studies detailing the life history and nesting chronology of the mourning dove in Oklahoma. By observing a large number of nests, she was able to conduct statistical analyses and draw some general conclusions on dove nesting and breeding behavior. In the late 1930's, McClure (1942) conducted important research on the life history of the mourning dove in Iowa. He was one of the first to describe a method of censusing the dove population by counting active nests in sample areas. McClure (1950) continued compiling statistics on mourning dove reproduction in Iowa, Nebraska, and California from 1938 to 1950.

Research was also beginning in the southern United States at this time. In October, 1935, the Alabama Cooperative Wildlife Research Unit was organized with the study of mourning dove management designated as a major project. Pearson and Rosene

(1938) began this project with observations on nesting, seasonal changes in gonad size, and growth rate of the young. Pearson and Moore (1939) and Moore (1940) continued research for the Cooperative Unit by investigating the nesting habits of doves in Alabama.

The first dove study under the Federal Aid (Pittman-Robertson) Act was conducted in North Carolina from 1939 to 1942 (Quay 1951). Quay's investigation produced more data on the duration, success, production, and density of nesting in the southern United States. The first region-wide dove study was instigated by the Southeastern Association of Game and Fish Commissioners (Southeastern Association of Game and Fish Commissioners 1957). This project, funded by the Federal Aid in Wildlife Restoration Program, began in September, 1948, with 10 southeastern states participating. An important contribution of this study was the development of the call count as an annual index to the status of breeding populations.

Following a noticeable decline in the dove population in the eastern United States in the early 1950's, Hanson and Kossack (1963) directed an intensive investigation on the mourning dove in Illinois. This research provided basic information on management, life history, distribution, mortality, and population dynamics.

Only 2 dove nesting studies have been conducted in Tennessee. Monk (1949) observed nesting in Centennial Park in Nashville, Tennessee and described the length of breeding season, nesting success, and productivity during the years 1934-1939, 1942, and 1946-1948. Hammond (1954) also observed nesting in Centennial Park

and briefly described the nesting success in his report on mourning doves in Tennessee.

The lengthy breeding season of mourning doves often extends into the hunting season. In recent years, there has been growing concern that the loss of breeding adults to hunting in September results in substantial loss of nestlings. To evaluate more fully the effects of September hunting, a Cooperative Mourning Dove Research Project, involving 27 states, was begun in late summer 1978. The investigation had 2 objectives:

- 1) To determine the proportion of annual mourning dove recruitment that occurs in September.

- 2) To determine the comparative recruitment rate in early September among areas in which hunting is permitted, evaluating the factors affecting nesting and fledgling success in hunted vs. unhunted areas.

This project addresses the first objective of the Cooperative study, determining September recruitment of mourning doves in east Tennessee. It also provides information lacking in the literature, such as nesting data for rural areas of east Tennessee. Specific objectives of this study were:

- 1) To establish the nesting chronology of mourning doves in east Tennessee.

- 2) To determine their regional ecology in terms of habitat, nesting, distribution, and productivity.

CHAPTER II

DESCRIPTION OF STUDY AREA

I. Location

The study area was located in the southwestern section of Knox County, approximately 25.8 Km west of the Knoxville city limits and 1.4 Km from the northeastern boundary of Loudon County (Figs. 1 and 2). The study area was divided into 2 sections, the size of each section limited to the habitat 1 person could search thoroughly in 6 hours. The study area covered a total of 271.2 ha. The northeast section (section 1) covered 162.9 ha and the southwest section (section 2) covered 108.3 ha.

II. Land Use and Vegetation

The dominant farming practice on the study area was husbandry of beef cattle. Most of the area was comprised of permanent pasture. A small portion of the northeast section was planted in corn and barley (Table 1). Hay was the only crop on the southwest section.

Forests on the study area consisted of small, isolated stands. Forested areas, totaling approximately 44.8 ha, were predominantly oak-hickory. Forested areas consisted of 50% or more upland oaks and hickory, with southern pine (Pinus virginiana and P. echinata) and eastern redcedar (Juniperus virginiana)

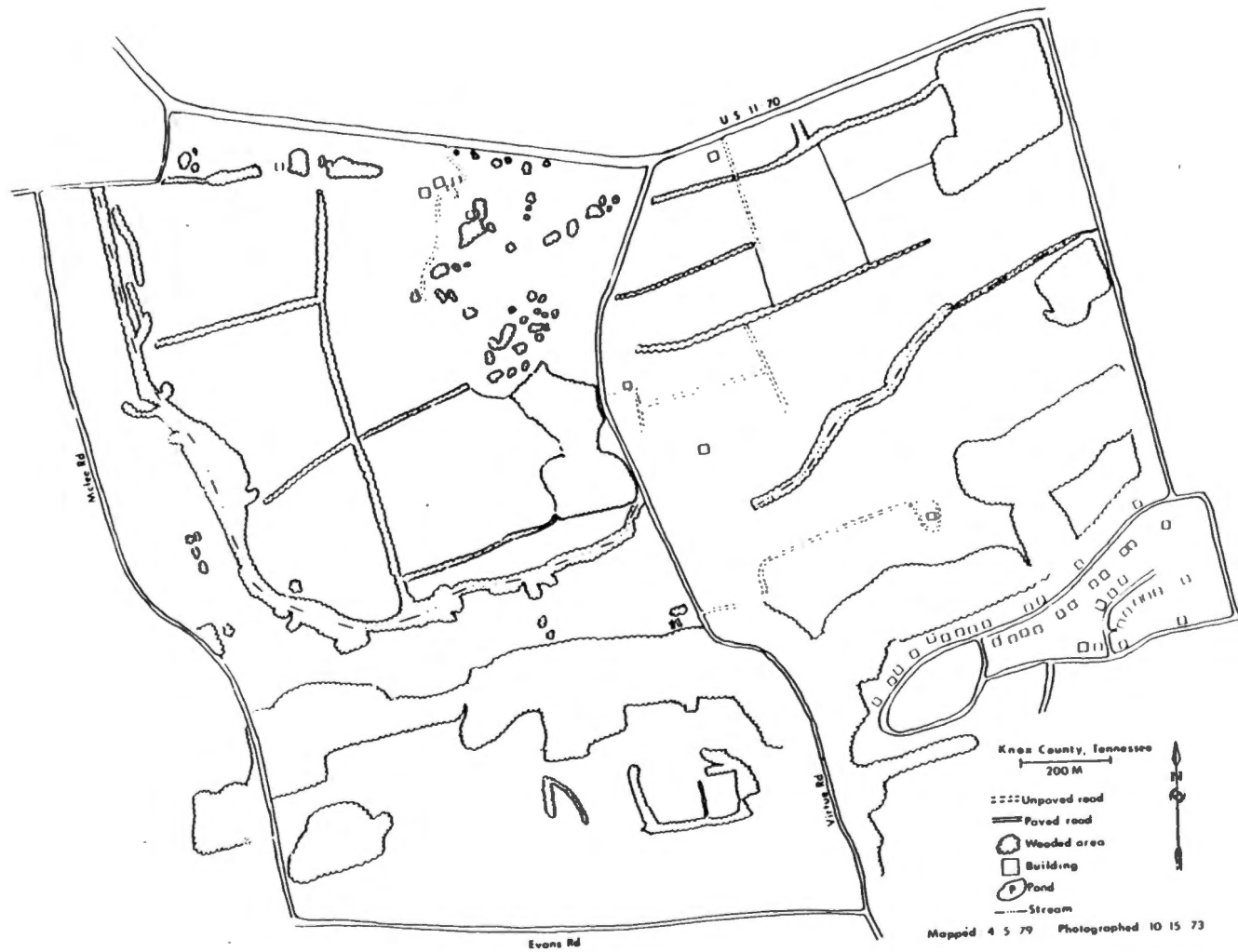


Figure 1. Map of Section 1 of the Study Area in Knox County, Tennessee.

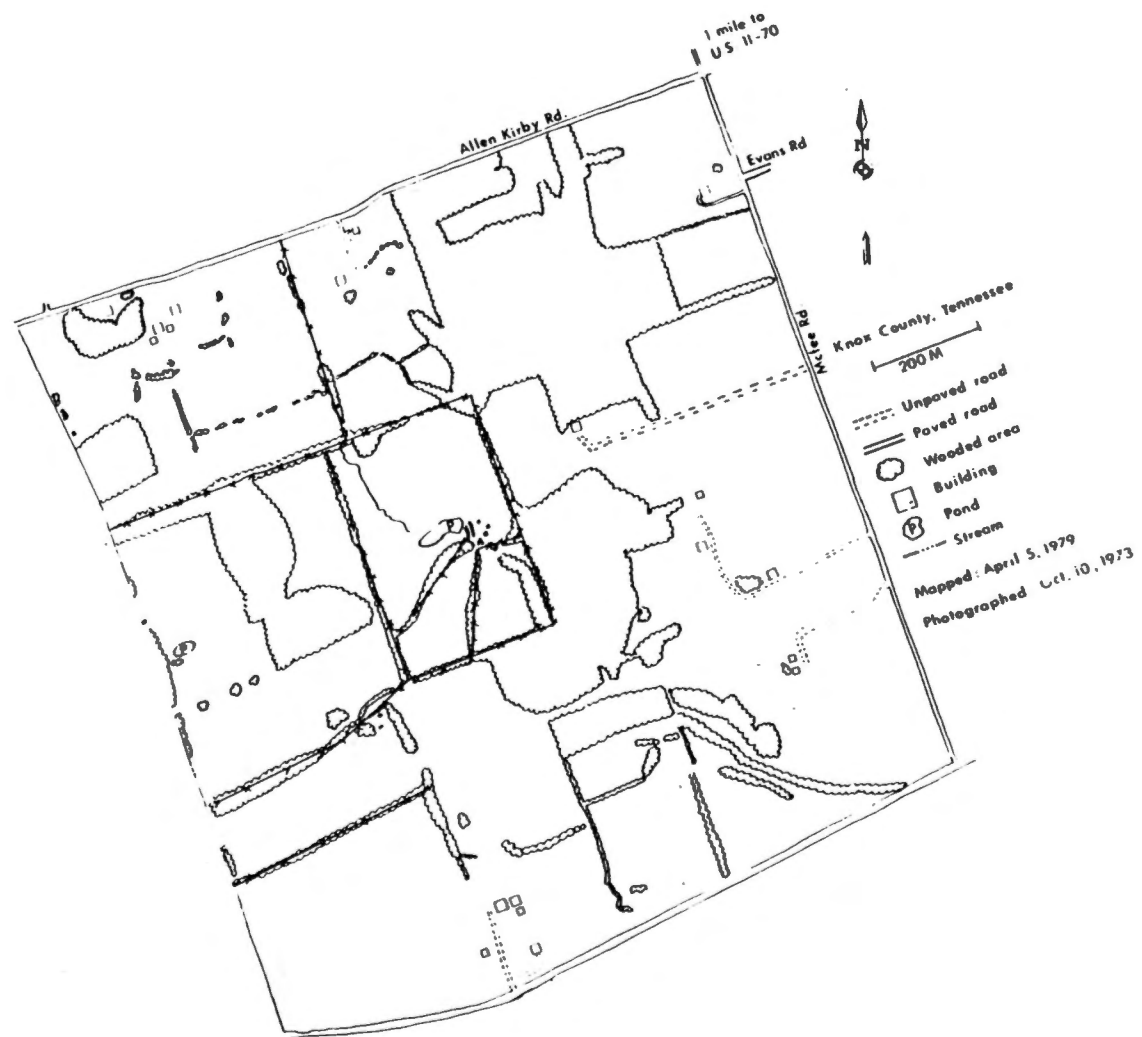


Figure 2. Map of Section 2 of the Study Area in Knox County, Tennessee.

Table 1. Distribution of Land Use Types on the Study Area in Knox County, Tennessee, 1979 and 1980.

Land Use	Hectares	Percentage Total Area
Pasture	197.5	72.8
Forest stands	44.8	16.5
Corn	11.5	4.2
Barley	9.9	3.7
Idle field	5.0	1.8
Orchard	1.0	0.4
Planted pine seedlings	1.5	0.6
Total	271.2	100

comprising 25% or less of the stand. Associated species included sweetgum (Liquidambar styraciflua), yellow-poplar (Liriodendron tulipifera), elm (Ulmus americana and U. rubra), and maple (Acer rubrum).

Wooded fencerows, woodlined roadsides, tree groves, and woodland edges were searched for nests on the area. Eastern red-cedar, hackberry (Celtis occidentalis), and sassafras (Sassafras albidum) were abundant tree species. Honeysuckle (Lonicera japonicus) and blackberry (Rubus sp.) occurred in almost all habitat types.

III. Topography

Knox County lies within the Ridge and Valley, or Great Valley, physiographic province of the southeastern United States (Roberts 1955). The rock exposures are chiefly dolomitic limestone, limestones, and shale. Weathering and geologic erosion have formed a system of parallel ridges and valleys extending in a northeast-southwest direction. The relief of the study area is predominantly rolling with no steep hills or gorges.

IV. Water Sources

Water was well distributed on the study area. Little Turkey Creek traversed 2.6 Km of the northeast section, providing a permanent water source to most of the area. One small pond was built on the northeast section in the summer 1980 for livestock.

Three ponds, each approximately 33 m in diameter, were located on the southwest section.

V. Climate

Knox County is located in a broad valley between 2 mountain ranges, the Cumberland Mountains to the northwest and the Great Smoky Mountains to the southeast, which greatly influence the climate of the Valley (NOAA 1979-80). The Cumberland Mountains retard and weaken cold winter air and both mountain ranges tend to modify hot summer winds. They also act as a fixed incline plane which lifts warm, moist air flowing northward from the Gulf of Mexico, increasing the frequency of afternoon thunderstorms in the summer months.

July is usually the warmest month of the year with average temperatures of 25.7 C (NOAA 1979-80). The coldest weather usually occurs in January. The monthly temperature averages 4.0 C, with an average daily minimum of -0.7 C. The change of seasons is gradual. The spring months of March, April, and May have an average monthly temperature of 9.7 C, 14.9 C, and 19.6 C, respectively. September, October, and November average a monthly temperature of 21.9 C, 15.4 C, and 9.1 C, respectively (NOAA 1979-80).

The total annual precipitation averages 122 cm. Precipitation is greatest in winter with a cumulative total of approximately 30.5 cm of snow, usually less than 10.2 cm at a time. March is usually the wettest single month with a monthly precipitation level of 13.3 cm.

The climatic conditions during the 2 year study period varied slightly from normal temperature and precipitation levels. February of both years was colder and dryer than normal. The spring of 1979 was warmer and precipitation slightly higher than normal while the summer of 1979 was cooler and precipitation levels below normal, except in July when precipitation was well above normal. The spring of 1980 was cooler and precipitation levels higher than normal. The summer of 1980 however was considerably hotter and precipitation levels considerably lower than normal.

CHAPTER III

METHODS

Nest searches were conducted both years of the study from February through the end of October. Each section of the study area was searched in toto once per week. Searches were conducted on the same day of each week unless circumstances such as severe thunderstorms prevented it. The objective was to locate all active nests on that section of the study area that day. Six hours were spent searching for nests and 2 additional hours were allocated for re-checking nests found on previous visits.

The method of search was generally linear, concentrating on fencerows, woodlined roadsides, and woodland edges. The overstory was scanned between the heights of 2.4 to 6.0 m, as doves are generally low nesters (Lund 1952). Eastern redcedars and trees densely covered with honeysuckle were checked for nests by separating limbs or lifting the covering vegetation. A small cosmetic mirror attached to a wire loop on an extendible, fiberglass shaft usually facilitated checking the contents of each nest with little disturbance. In some instances, it was necessary to climb the nest tree to determine the contents of the nest.

When a nest was located, the parent was flushed to facilitate inspection of the nest. Only active nests (those containing 1 or more eggs or nestlings) were recorded. Nests without eggs or nestlings were later rechecked. A data form, supplied by the U.S.

Fish and Wildlife Service, was completed for each active nest (Appendix 1). The age of nestlings was estimated in days by the method described by Hanson and Kossack (1963). Causes of nest loss were recorded as predation, weather, human disturbance or unknown.

Each nest was revisited once per week and appropriate data were entered in a personal field book and on the data form. All nests were checked when the squabs reached the age of 10 days. Hanson and Kossack (1963) determined this to be the earliest age at which the young could fledge the nest. The exact fledging date was determined by visiting the nest daily from day 10 of brooding until the young were fledged.

The date of nest initiation was estimated to be 14 days prior to the date of hatching. When a nest was destroyed in the egg stage, the date of nest initiation was estimated as 3 days before that search day on which the eggs were first located.

Statistical Analysis

The small sample size in this study precluded any detailed statistical analysis. Means were used to indicate number eggs hatched per nest, number of fledglings per nest, per successful nest, and per breeding pair. Means were also used to indicate breeding and production density.

CHAPTER IV

RESULTS

A total of 48 mourning dove nests was found, 17 during 1979 and 31 during 1980. Thirty-four nests were located on the northeast section and 14 on the southwest section.

I. Nest Initiation

Courtship activity was observed in early February both years of the study. The beginning of the nesting season was marked by the initiation of the first nest.

In 1979, the first active nest was initiated 24 March and nest initiation peaked in April (Fig. 3). The number of nests initiated dropped in May and rose again in June. Sixteen of the 17 nests located (94.1%) were initiated by the end of June with the remaining nest initiated 3 August 1979.

In 1980, the first nest was initiated 22 March. Nest initiation peaked in April, dropped in May, and rose again slightly with 6 nests initiated in June and July.

By the end of June, 20 nests (64.5%) had been initiated. Four nests were initiated in August and 1 in September. The last nest was initiated 5 September 1980.

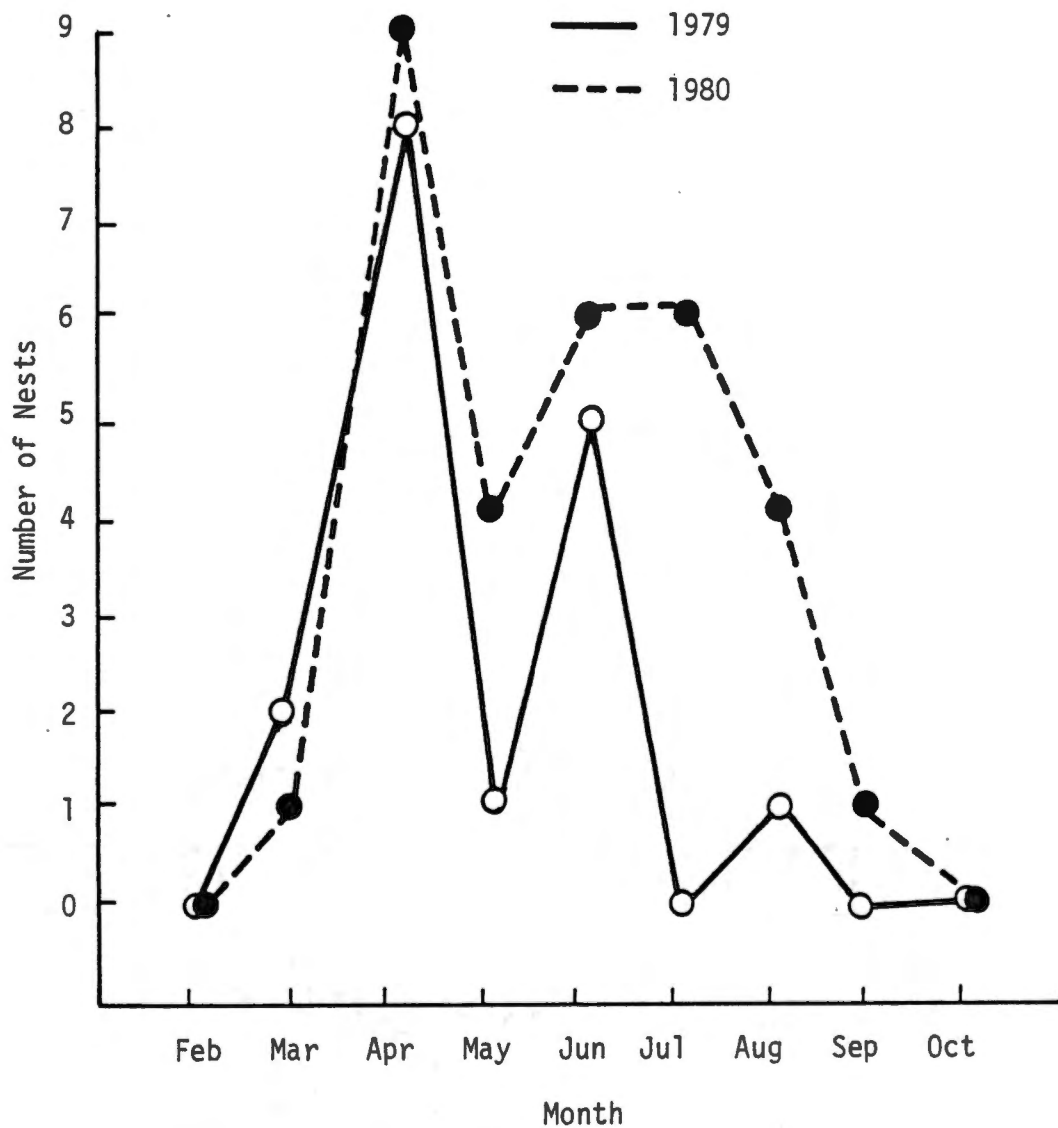


Figure 3. Total Number of Nests Initiated Each Month Between 1 February and 31 October on the Study Area in Knox County, Tennessee, 1979 and 1980.

II. Clutch Size and Hatching

All nests for which clutch size was known contained 2 eggs. A total of 34 eggs was laid in 1979 and 59 eggs were laid in 1980. In 1979, 7 nests (41.2%) contained eggs that hatched and 20 nests (64.5%) contained eggs that hatched in 1980.

In 1979, 13 eggs (38.2% of those laid) were successful in hatching. The first eggs hatched on 10 April 1979. A hatching peak occurred from 10 April to 24 April, during which 7 eggs (53.8%) hatched (Table 2). The last eggs hatched 24 June 1979.

Thirty-three eggs (60% of those laid) hatched in 1980. The first eggs hatched 5 April 1980. Eight eggs (24.2%) hatched in April, slightly more than hatched in any other month. By the end of June, 16 eggs (48.5%) had hatched (Fig. 4). Three eggs hatched 8 September and 4 eggs hatched 11 September 1980.

III. Fledging

During the 1979 season, broods were fledged only in the months of April, May, and June. The first young left the nest on 22 April 1979 with the peak in fledging occurring in May. No nests initiated after June produced young, the last young fledging the nest 7 June 1979.

The peak in fledgling production was markedly later in 1980 than 1979. The first fledglings left the nest 26 April 1980, but the peak in fledgling production occurred in August and September

Table 2. Number of Eggs Hatched and Young Fledged Each Month on the Study Area in Knox County, Tennessee, 1979 and 1980.

Month	Number Eggs Hatched				Number Young Fledged			
	1979		1980		1979		1980	
	n	%	n	%	n	%	n	%
April	7	53.8	8	24.2	3	30.0	1	6.7
May	4	30.8	4	12.1	6	60.0	3	20.0
June	2	15.4	4	12.1	1	10.0	0	0.0
July	0	0.0	7	21.2	0	0.0	2	13.3
August	0	0.0	3	9.1	0	0.0	4	26.7
September	0	0.0	7	21.2	0	0.0	5	33.3
October	0	0.0	0	0.0	0	0.0	0	0.0
Total	13	100	33	100	10	100	15	100

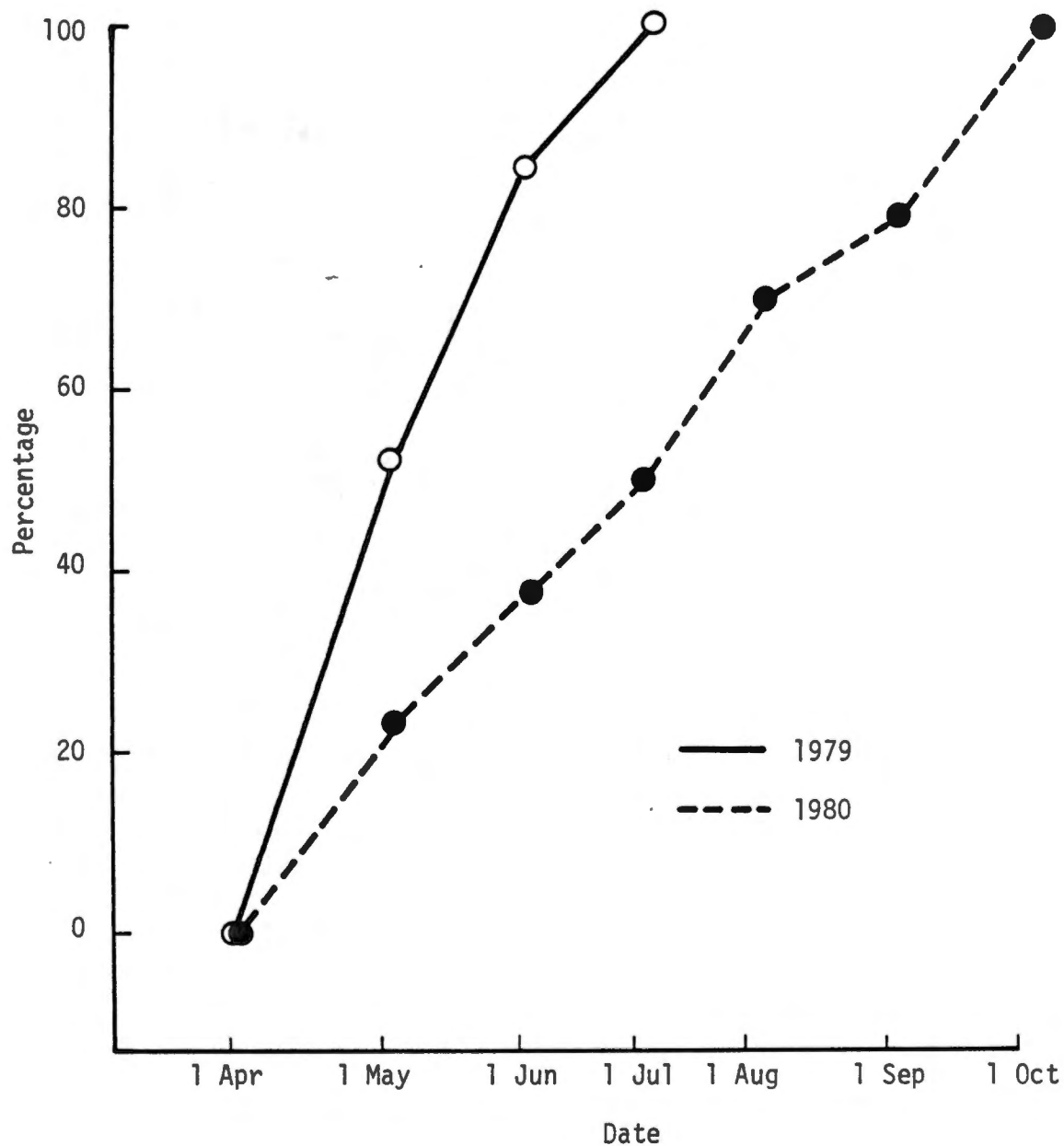


Figure 4. Cumulative Percentage of Eggs Hatched on the Study Area in Knox County, Tennessee. 1979--13 eggs, 1980--33 eggs.

(Table 2). In 1979, all young had left the nest by the end of June while only 4 young (26.7%) had fledged by that date in 1980 (Fig. 5). Eleven of the 15 young produced in 1980 fledged in July, August, and September. Five young fledged the nest in September with the last young fledging 24 September 1980.

IV. Duration of Nesting Season

The length of the nesting season was measured in days from the initiation date of the first nest to the day the last nest was completed or recorded as failed. This period encompassed 142 days in 1979 and 185 days in 1980. The nesting season was 30.3% longer in 1980 than 1979.

V. Distribution of Nesting Effort

Nesting activity in 1979 was highest in the first half of the nesting season (March-June) (Fig. 6). Over half of the season's total nests were initiated by the end of April and the highest number of active nests (nests containing eggs or nestlings) occurred in April. One nest was initiated after 1 July and only 4 nests (23.5%) were active in July and August. In 1979 there were no active nests in September.

Nesting activity extended well into the latter half of the 1980 study period (July-October). During the period from 1 July to 30 September 11 nests (35.5%) were initiated. Nesting activity was most intense during July and August with 9 and 10 active nests,

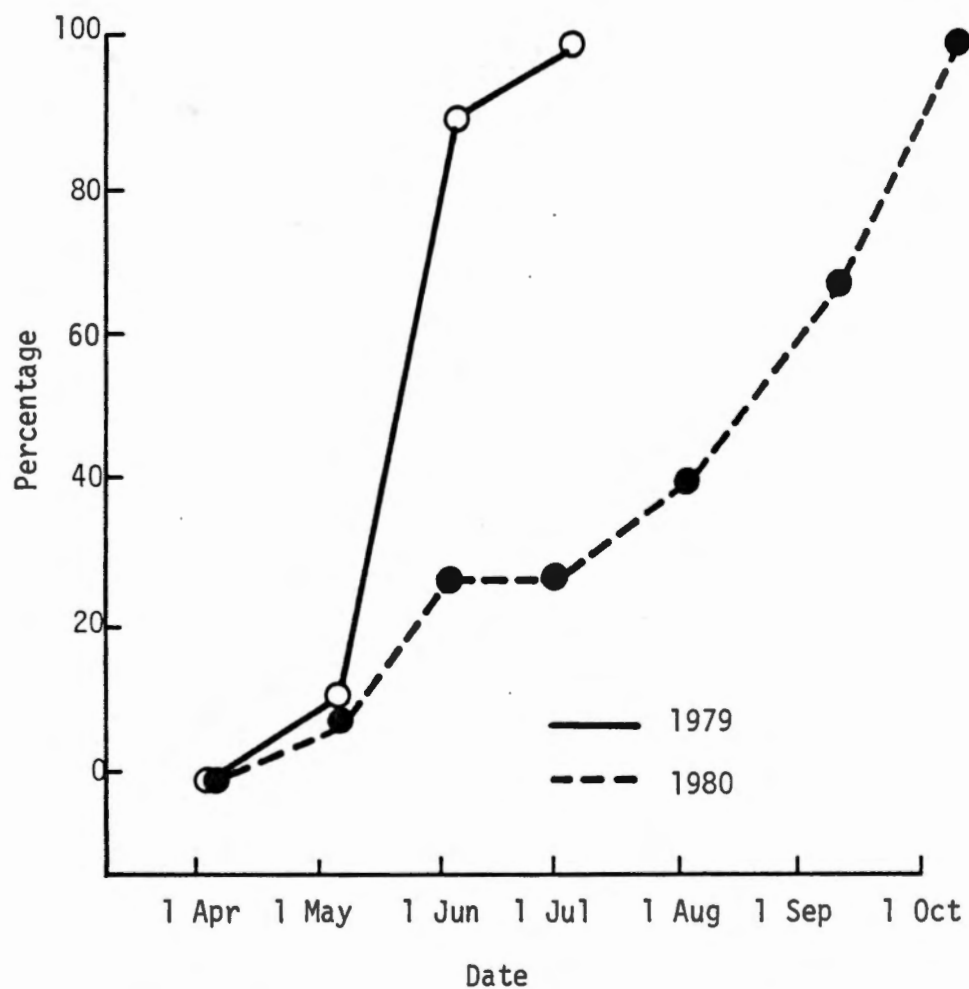


Figure 5. Cumulative Percentage of Young Fledged on the Study Area in Knox County, Tennessee. 1979--10 young, 1980--15 young.

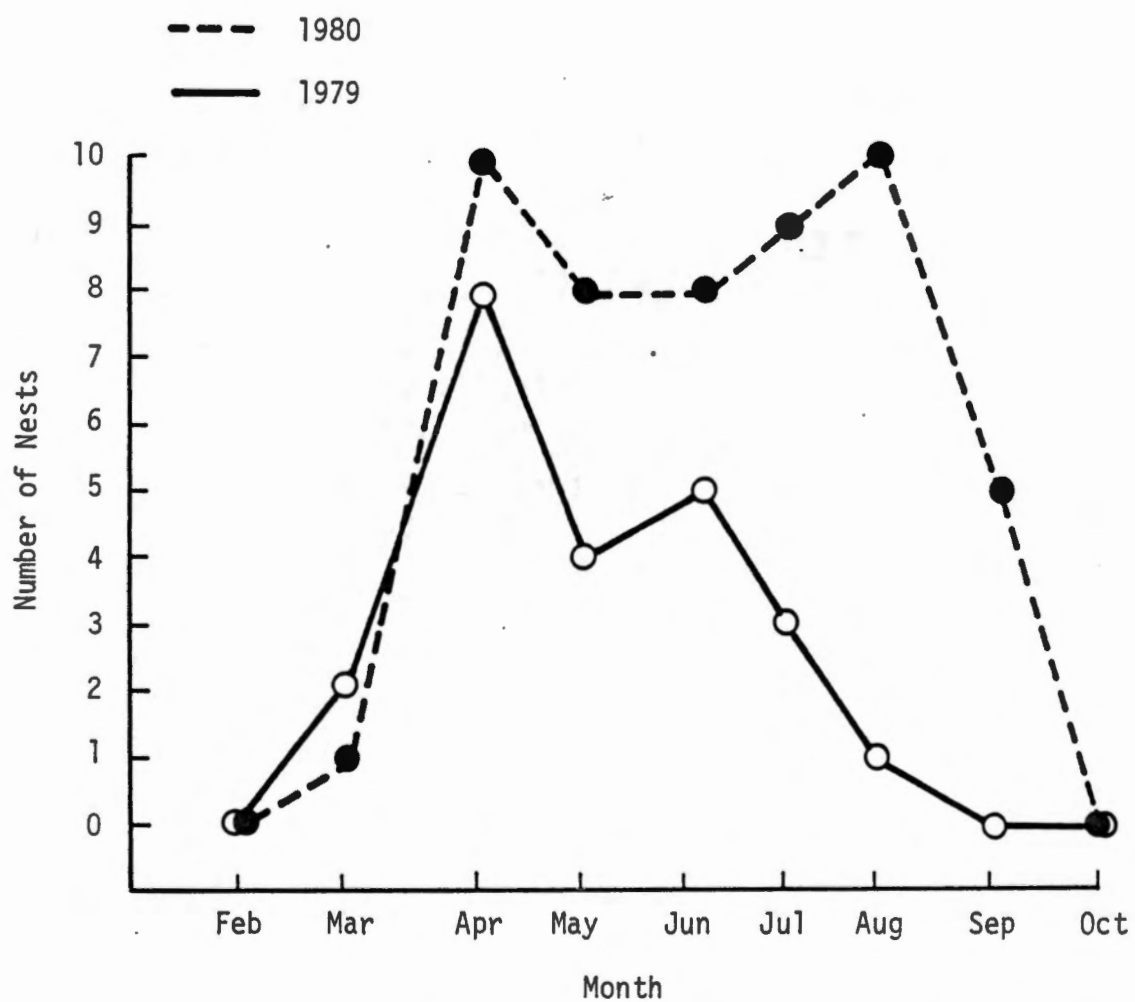


Figure 6. Total Number of Active Nests Each Month Between 1 February and 31 October on the Study Area in Knox County, Tennessee, 1979 and 1980.

respectively, occurring during these months. Although only 1 nest was initiated in September, 5 nests were active during that month.

VI. Nesting Success

For this study, a nest was considered successful if at least 1 young fledged. In 1979, 6 nests (35.3%) were successful, with all successful nests occurring within the first half of the study period (March-June). In 1980, 10 (32.3%) were successful. Three nests were successful in the first half of the 1980 study period and 7 during the latter half.

VII. Nest Destruction

It was likely that predation and weather were major factors in nest destruction, but the cause of most nest losses was unknown due to lack of evidence at the nest site (Table 3). Crows (Corvus brachyrhynchos), blue jays (Cyanonitta cristata), opossums (Didelphis marsupialis) and black rat snakes (Elaphe obsoleta obsoleta) were abundant predators on the study area. Typical signs of nest predation included feathers scattered below or near the nest, visceral remains in the nest, a nest torn from the supporting vegetation, or cracked or punctured eggs. Two nests were believed lost to predators in 1979 and 3 nests were preyed upon in 1980.

Heavy rains and high winds were also responsible for nest loss. Four nests were thought destroyed by inclement weather in 1979 and 1 nest loss was attributed to weather in 1980.

Table 3. Causes of Nest Failure on the Study Area in Knox County, Tennessee, 1979 and 1980.

Destructive Factor	Number of Nests			Percentage
	1979	1980	Total	
Unknown	5	13	18	56.2
Weather	4	1	5	15.6
Predator	2	3	5	15.6
Human disturbance	0	2	2	6.3
Desertion	0	2	2	6.3
Total	11	21	32	100

Desertion and human disturbance were other causes of nest failure. Two nests failed because of human disturbance and 2 nests were deserted in 1980. One nest, containing eggs, was deserted during the week 7 July-14 July 1980. The other nest, containing nestlings approximately 2 days old when located, was deserted during the week 10 September-18 September 1980.

VIII. Production

Mourning doves initiated 17 nests on the study area in 1979 and 31 nests in 1980. Ten and 15 young were produced in 1979 and 1980, respectively. The nesting density was 1.3 nests per 20 ha in 1979 and 2.4 nests per 20 ha in 1980 (Table 4).

An estimate of the minimum number of different breeding pairs on the study area was determined from the greatest number of active nests during 1 weekly period of the nesting season (Harris et al. 1963). There was a minimum of 6 breeding pairs on the study area in 1979 and 8 pairs in 1980.

Production Per Nest Attempt

Fledgling production was 0.6 young per nest attempt in 1979 and 0.5 young per nest attempt in 1980 (Table 5). A mean of 1.7 young was produced per successful nest in 1979 and 1.5 young per successful nest in 1980 (Table 6).

Production Per Breeding Pair

Mourning doves made 2.8 nest attempts per breeding pair in 1979 and 3.9 nest attempts per pair in 1980. The average number of

Table 4. Mourning Dove Production Per Breeding Pair on the Study Area in Knox County, Tennessee, 1979 and 1980.

Nesting Season	Number Nests	Breeding Pairs	Nest Attempts Per Breeding Pair	Successful Nests Per Pair	Young Produced Per Pair
1979	17	6	2.8	1.0	1.7
1980	31	8	3.9	1.3	1.9

Table 5. Mourning Dove Production of Young Per 100 Eggs Laid and Per Nest Attempt on the Study Area in Knox County, Tennessee, 1979 and 1980.

Nesting Season	Number of Young Fledged	Young Fledged Per Nest Attempt	Young Fledged Per 100 Eggs Laid
1979	10	0.6	29.4
1980	15	0.5	25.4

Table 6. Nesting Success and Productivity on the Study Area in Knox County, Tennessee, 1979 and 1980.

Nesting Season	Number of Nests	Successful Nests n (%)	Number of Young Fledged	Young Fledged Per Successful Nest
1979	17	6 (35.3)	10	1.7
1980	31	10 (32.3)	15	1.5
Total	48	16	25	1.6

successful nests per pair was 1.0 in 1979 and 1.3 in 1980, resulting in the production of 1.7 young per pair in 1979 and 1.9 young per pair in 1980.

Production Density

The production of fledglings was 0.7 young per 20 ha in 1979 and 1.1 young per 20 ha in 1980 (Table 7).

IX. Nesting Habitat

Nesting habitat for the mourning dove in this area is predominantly edge, e.g., fencerows, woodland edge, etc. The study area contained 4 general habitat types (Table 8). During both years of the study, all nests were found in 3 habitat types--wooded fencerows, isolated trees, and clumped trees. Twenty nests (41.7%) were located in wooded fencerows with an equal proportion of nests (29.2%) occurring in isolated and clumped trees.

Nesting Vegetation

Eastern redcedar, hackberry, and honeylocust were commonly occurring tree species and also the most commonly used as nesting sites (Table 9). Thirteen nests (76.5%) were built in these 3 tree species in 1979 and 16 nests (51.6%) in 1980.

Height of Nests and Dominant Vegetation

Nest height ranged from 1.2 to 7.5 m, with a mean of 3.0 m (Table 10). Most nests were located between 1.0 m and 5.0 m above the ground.

Table 7. Mourning Dove Nesting and Fledgling Density on the Study Area in Knox County, Tennessee, 1979 and 1980.

Nesting Season	Number Nests	Breeding Pairs	Breeding Pairs Per 20 ha	Nests Per 20 ha	Fledglings Per 20 ha
1979	17	6	.4	1.3	0.7
1980	31	8	.6	2.4	1.1

Table 8. Habitat Types Used as Nesting Sites by Mourning Doves on the Study Area in Knox County, Tennessee, 1979 and 1980.

Habitat Types	Number of Nests				Total	
	1979		1980			
	Section 1	Section 2	Section 1	Section 2	n	%
Wooded fencerows	4	3	6	7	20	41.7
Isolated tree	3	1	8	2	14	29.2
Clumped trees	5	1	8	0	14	29.2
Woodland edge	0	0	0	0	0	0
Total	12	5	22	9	48	100

Table 9. Tree Species Used for Nest Sites by Mourning Doves on the Study Area in Knox County, Tennessee, 1979 and 1980.

Species	Number of Nests		
	1979	1980	Total
Eastern redcedar	4	9	13
Honey locust (<u>Gleditsia triacanthos</u>)	5	4	9
Hackberry	4	3	7
Common privet (<u>Ligustrum vulgare</u>)	1	2	3
Eastern redbud (<u>Cercis canadensis</u>)	0	2	2
American elm	0	2	2
Black cherry (<u>Prunus serotina</u>)	1	1	2
Flowering dogwood (<u>Cornus florida</u>)	0	2	2
Red maple	1	1	2
Sassafras	0	2	2
Southern red oak (<u>Quercus falcata</u>)	0	1	1
Apple (<u>Malus</u> sp.)	1	0	1
Sweetgum	0	1	1
White ash (<u>Fraxinus americana</u>)	0	1	1
Total	17	31	48

Table 10. Height of Mourning Dove Nests and Height of Dominant Vegetation on the Study Area in Knox County, Tennessee, 1979 and 1980.

Height (Meters)	Number of Nests			
	Nest Height		Vegetation Height	
	n	%	n	%
1.0-3.0	31	64.6	3	6.3
3.1-5.0	15	31.2	11	22.8
5.1-7.0	2	4.2	19	39.6
7.1-9.0	0	0.0	10	20.8
9.1-11.0	0	0.0	1	2.1
11.1-13.0	0	0.0	1	2.1
13.1-15.0	0	0.0	3	6.3
Total	48	100	48	100

The height of dominant vegetation (vegetation in which the nest was found) ranged from 2.7 m to 15 m, averaging 7.4 m.

Secondary Use of Nests

There were 2 instances of mourning doves nesting in nest structures previously used during the season in 1979 and 1980. The intervals between the completion of one nest to the initiation of the next clutch were 17 and 3 days in 1979 and 10 days and 43 days in 1980. The initial nesting attempt in all instances was successful, but neither of the second attempts was successful in 1979 and only 1 second attempt was successful in 1980.

In 1980 there were also 2 instances of doves using nests built by other species. Nests built by a robin (Turdus migratorius) and a brown thrasher (Toxostoma rufum) were utilized by mourning doves.

CHAPTER V

DISCUSSION

I. Nesting Chronology

Initiation of Nesting

Cooing and courtship flights were noted in January and February both years of this study, but nesting did not begin until late March in either year. The first nests were initiated 24 March 1979 and 22 March 1980. Cole (1933) demonstrated that increasing daylight is the external stimulus for reproductive activity in the mourning dove. Pearson and Rosene (1938) also noted a distinct seasonal trend in testes enlargement in the male mourning dove. The effect of other environmental factors, such as changing temperature, light intensity, rainfall, and food on the annual cycle in birds has been investigated, but the springtime increase in day length proved to be the predominant influence (Welty 1975). Some researchers speculated that prevailing weather conditions are responsible for year to year variability in the onset of nesting. Lund (1952) noticed that cold temperatures and frequent rain and snow deterred nesting in Michigan. Hanson and Kossack's (1963) research indicated that temperatures determine the phenology of both migration and nesting in mourning doves in Illinois. Doves begin nesting earlier in warmer springs. In this study, there was little evidence that temperature affected the onset of nesting.

March 1979 was 2 C warmer than normal, precipitation was 2.5 cm below the monthly normal, and only trace amounts of snow fell. In contrast, March 1980 was exceptionally rainy, temperatures were below normal, and 8.9 cm of snow fell the first and second day of the month. Still nesting began on approximately the same date both years of the study. It is likely that the variation in weather conditions between 1979 and 1980 was insufficient to cause a noticeable difference in nest initiation between years.

Burch (1982) found that mourning doves on his urban study area in Knox County began nesting 26 February 1979 and 20 February 1980. This was almost 6 weeks earlier than the beginning of nesting on his rural area in Loudon County, Tennessee and almost 4 weeks earlier than the initiation of nesting in this study. He speculated that the urban population consisted of local winter residents and the rural population consisted of migrants that perhaps begin nesting later than resident birds. He also suggested that the social stimuli provided by a concentrated breeding population on the urban area could have been responsible for earlier nesting on that area, and that local differences in temperature between rural and urban study areas may also have influenced the onset of nesting.

Monthly Nesting Activity

The peak in nest initiation occurred in April both years of the study. However, monthly nesting activity varied greatly

between 1979 and 1980. Nest initiation and overall nesting activity peaked in April 1979. Nesting activity sharply declined after June 1979. In 1980, nest initiation and nesting activity extended into September.

Even though there was little evidence that weather affected the onset of nesting in the spring, it appeared that there was a relationship between weather conditions and nesting activity in midsummer of the nesting season. The extremely wet weather in July 1979 apparently deterred initiation of new nests in that month. Even though weather conditions returned to near normal in August 1979, only 1 nest was initiated. All nesting activity in the 1979 nesting season was completed by August. In contrast to the overcast, rainy weather in July 1979, temperatures in July and August 1980 were considerably above normal and rainfall well below normal. High summer temperatures have been reported to depress breeding of birds (Hopkins and Odum 1953, Taylor 1941). However, nesting activity on the study area continued at a high level during this time (9 and 10 nests were active in July and August, respectively).

Burch (1982) noted that above normal rainfall in the summer 1979 was accompanied by a rapid decline in nest initiation on his study areas in Knox and Loudon Counties. He also reported that the extreme heat and drought occurring in summer 1980 had no suppressing effect on nesting activity (50.0% of all nests during 1980 were initiated in July and August on his rural area in Loudon County, Tennessee).

The variation in peak nesting activity between 2 consecutive nesting seasons is not unusual. In his Iowa nesting study, McClure (1942) found distinct nesting peaks during different months in 1938 and 1939. In Louisiana, Soileau (1960) reported that peak nesting activity was reached during May and June in 1956, June in 1958, and during July in 1959. This study indicates that April through July is an important period for nest initiation. Even though the level of nest initiation drops after July, nesting activity of mourning doves in east Tennessee is still in progress in September in some years.

Monthly Production

Monthly production of young varied considerably between 1979 and 1980 (Table 2, page 16). In 1979, 3 young fledged in April and 6 young fledged in May. This accounted for 90% of the fledglings in the 1979 season. No young were successful in fledging after June 1979. In 1980, only 4 young (26.7%) had fledged by the end of June. The peak of fledging was reached in September.

The inclement weather in July may have deterred further nesting and fledgling production in late summer of the 1979 season. The extreme heat and drought that occurred during the summer 1980 had no apparent adverse effect on nesting activity as evidenced by the high fledgling levels in August and September. Burch (1982) also observed an early fledging peak in 1979 compared to 1980 on both his rural and urban study areas in Loudon and Knox Counties. Peak levels of fledging were reached during the months of May and June in 1979 and during September in 1980 on his rural area.

He also attributed the difference in monthly production between years to the possibility that overcast, rainy weather during the summer of 1979 curtailed further nesting and consequently lowered later production. Burch (1982) also noted that the peak levels of production occurring in late summer 1980 were evidence that the heat and drought of that summer seemingly had no effect on nesting activity. In middle Tennessee, Monk (1949) noted that the percentage of broods leaving the nest was evenly distributed over the summer months; 17.2% fledged in September compared to 19.7% fledging in June and 18% fledging in July and August.

The proportion of annual recruitment which occurs in September has been an important consideration since enactment of the Migratory Bird Treaty Act in 1918 which allows states that permit hunting to open their hunting seasons 1 September. This study indicates that production of young in September varies from year to year in the same area. In 1979, there were no young produced in September due to the cessation of all nesting activity in August. However, in 1980, 5 young (33.3% of the season's total fledglings) were produced after 1 September. Burch (1982) noted similar between-year variability in September production of young on his rural area in Loudon County, Tennessee. In 1979, no young were produced after 1 September, but in 1980, 7 young (35.0%) were produced on the same area. The difference in September production was not as pronounced on his urban area in Knox County. Two young (6.0%) were produced after 1 September 1979 and 10 young (10.2%) were produced after

1 September 1980. As stated earlier, Monk (1949) reported that 17.2% of the total number of successful broods left the nest after 1 September on his study area in Nashville, Tennessee.

Percentages of young fledged after 1 September reported in other mid-latitude states were 2.0% in Illinois (Hanson and Kossack 1963), 21.9% in Iowa (McClure 1950), 13.0% in Kansas (Schroeder 1970) and 0.0% in Virginia (Sprunt 1957). Farther south, percentages of young fledged after 1 September were 6.8% in Louisiana (Soileau 1960), 7.8% in Mississippi (Handley and Edwards 1957) and less than 10% in Texas (Swank 1955). A review of the literature by the USFWS (1977) indicated that about 9.6% of all young produced in a season are fledged after 1 September throughout the United States.

Five nests were active in September 1980 and 2 nests were unsuccessful. The failure of 1 nest was definitely attributed to desertion. The nest, containing squabs approximately 2 days old, was located 9 September 1980. The decayed remains of the young were observed upon return to the nest on 18 September. Hunting was allowed in areas surrounding the study area and it is possible that the parents were killed by hunters. Burch (1982) reported that only 1 nest active in September was unsuccessful. Its loss was not attributed to hunting due to its location on the urban area in Knox County where hunting was not believed to be a factor.

The recruitment of mourning doves in September appears little affected by hunting pressure. However, nesting is still in progress when hunting seasons open 1 September. This study indicates that if

there were to be no overlap between the nesting and hunting season, the earliest opening date would be 1 October.

Duration of the Nesting Season

The nesting season encompassed 142 days in 1979 and 185 days in 1980. The inclement weather during July 1979 was probably responsible for the shorter nesting season in that year. Burch (1982) reported that doves nested on his rural area in Loudon County, Tennessee, over a period of 143 days in 1979 and 183 days in 1980, very similar to the length of the nesting season observed in this study. The nesting season on his urban area in Knox County was longer, encompassing 222 days in 1979 and 219 days in 1980.

The length of the nesting season in a given year may be strongly influenced by weather conditions existing in mid to late summer. Cole (1933) reported that the success or failure of nests attempted in August could also affect the length of the nesting season. He speculated that a pair with a successful nest at the end of August probably would not nest again. However if a nest was broken up early in the month or the young died in the middle of August, another nesting would be likely.

The average nesting season for rural east Tennessee probably extends from late March to the end of September, about 185 days. This agrees with Burch's (1982) estimation of the length of nesting season in east Tennessee and Monk's (1949) estimation of the length of the nesting season in Nashville, Tennessee.

II. Nesting Success

Success of Eggs and Nestlings

In 1979, 34 eggs were laid, 13 eggs (38.2%) hatched, and 10 young (76.9% of those hatched) survived to fledge the nest. In 1980, 59 eggs were laid, 33 (60.0%) hatched, and 15 young (45.6% of those hatched) were successful in fledging. Generally, eggs are considered more vulnerable to decimating factors than are nestlings (McClure 1942, Fichter 1959, and Burch 1982). McClure (1942) attributed the higher survival of young to the fact that parents increase their protection of the nest, that young tend to cling to the nest with their large, strong feet, and that the additional weight gain of the young offers stability to the nest.

Nest Success

The rate of nest success (fledging at least 1 young) was 35.3% in 1979 and 32.3% in 1980. An abundance of predators on the study area may have been responsible for the low rate of nest success. Nest success in this study was lower than reported in the literature. Only Caldwell (1955, 1964) reported similar rates of 35.4% and 35% in his study of dove production in Michigan. On his rural study area in Loudon County, Tennessee, Burch (1982) reported a success rate of 38.9% in 1979 and 61.1% in 1980, with a mean success rate of 50.0%. Monk (1949) noted a success rate of 52% on his study area in Middle Tennessee. Other studies conducted in the southeast revealed success rates similar to

Monk's: 52% in Alabama (Pearson and Moore 1939), 52% in Virginia (Sprunt 1957), and 50% in North Carolina (Quay 1951).

Many dove production studies have shown that nesting success increases in the latter months of the breeding season (Nice 1923, Quay 1951, Hanson and Kossack 1963, and Caldwell 1964). In 1979, all successful nests occurred within the first half of the season (March-June), but very few nests were even active in the second half of the season (July-September). In 1980, nesting success did increase in the latter months of the breeding season. Seven nests were successful compared to 3 successful nests early in the season. Nice (1923) attributed a seasonal increase in nest success to several factors. Weather was one consideration. Storms were likely to be more severe in the spring months than later in the season. An abundance of natural predators in the spring and the absence of concealing foliage was another factor. Nice (1923) also speculated that doves gain experience as the season progresses and this results in more successful nests.

III. Production

Breeding Population

Several authors (McClure 1942, Fichter 1959, and Caldwell 1964) considered the greatest number of different nests recorded on 1 day during a nesting season to be indicative of the number of breeding pairs on a given area. Hopkins and Odum (1953) and Lowe (1956) pointed out that this method would likely underestimate the

breeding population due to the fact that it is improbable that all breeding pairs would have active nests at any one time and some nests are probably overlooked. Harris et al. (1963) believed that the number of different nests active in any one weekly period would give a more accurate estimate of the number of breeding pairs on an area. This method was followed by Burch (1982) and in this study. There was an estimate of 6 and 8 different breeding pairs on the study area in 1979 and 1980. Even though this method resulted in higher estimations than the method described by McClure (1942), the actual breeding population was probably still underestimated. It is probable that several nests were completely overlooked due to the abundance of nesting cover on the area. Burch (1982) estimated that there were 6 and 5 different breeding pairs on his rural study area in Loudon County in 1979 and 1980. He, too, considered his estimation to be lower than the true breeding population on his area.

Breeding Density

The breeding density on the study area was 0.4 and 0.6 breeding pairs per 20 ha in 1979 and 1980, respectively. Burch (1982) noted a breeding density of 0.5 pairs per 20 ha on his rural area in Loudon County, Tennessee in 1979 and 1980. Hopkins and Odum (1953) reported that low breeding densities are characteristic of regions with abundant nesting habitat due to scattered nesting of mourning doves. They estimated an average of 1.6 breeding pairs

per 20 ha on their study areas in the Coastal Plain and Piedmont regions of Georgia. Lowe (1956) estimated a breeding density of 1.3 pair per 20 ha in the Central Piedmont region of Georgia. In North Carolina, Quay (1951) reported an average of 1.5 breeding pairs per 20 ha. Hopkins and Odum (1953) speculated that where nesting cover is abundant and nesting doves are relatively scattered, the actual density on study areas may come close to reflecting density over large areas. Although breeding density in Knox County and east Tennessee is probably not as low as the estimations in this study, the breeding density in this study may reflect low breeding densities of mourning doves in Tennessee farmland as a whole.

Productivity

Production in terms of unit of habitat has been estimated by several authors (Lowe 1956, McClure 1942, Taylor 1941). The diverse nesting habitat utilized by doves prevents direct comparisons in terms of productivity (Southeastern Association of Game and Fish Commissioners 1957). Fichter (1959) believed it may be useful to compare production values per unit area in similar breeding situations. Burch's (1982) rural study area in Loudon County, Tennessee was very similar to the study area in this study in terms of abundance and vegetative composition of nesting sites. Production density in this study ranged from 0.7 young per 20 ha in 1979 to 1.1 young per 20 ha in 1980. Burch (1982) reported a

density of 1.2 young per 20 ha in 1979 and 1.8 young per 20 ha in 1980 on his rural area. Such production densities may be characteristic of farmland in east Tennessee, but density could be expected to vary with the amount of contiguous wooded fencerow and other nesting habitat types.

Mourning dove productivity has been expressed in various other ways in the literature. Fichter (1959) stated that nesting attempt and the egg (attempted fledgling) are the units of reproductive effort which are the basis for standard expressions of productivity. He concluded that the number of young fledged per 100 eggs laid and the number fledged per nest attempt were the most accurate expressions of breeding success. Fichter (1959) summarized several studies and found that the number of fledglings per 100 eggs laid ranged from 44.5 to 70.3 and the fledgling production per nest attempt varied between 0.85 and 1.38. In this study, 29.4 and 25.4 young fledged per 100 eggs laid in 1979 and 1980, respectively. Fledgling production per nest attempt was 0.6 in 1979 and 0.5 in 1980. In 1979, Burch (1982) noted the number of young produced per 100 eggs laid ranged from 38.2 (rural study area) to 78.6 (urban study area) and the fledglings produced per nest attempt ranged from 0.7 (rural area) to 1.6 (urban area). Fichter (1959) considered the number of young fledged per breeding pair as "the unit of reproductive success basic to the manipulation of hunting seasons and bag limits." The U.S. Fish and Wildlife Service (1977) summarized several productivity studies and found

that estimations of fledglings per breeding pair ranged from 1.4 to 7.0. In this study, fledgling production was 1.7 and 1.9 young per breeding pair in 1979 and 1980, respectively. Burch (1982) reported a fledgling production of 2.2 young per pair in 1979 and 4.0 young per pair in 1980 on his rural area in Loudon County, Tennessee. Mourning doves produced 5.5 young per pair in 1979 and 6.1 young per pair in 1980 on his urban area in Knox County, considerably higher than the estimated production on his rural area and the estimates in this study.

The Southeastern Association of Game and Fish Commissioners (1957) estimated that production must be 4.6 young per pair to maintain a population of doves sustaining a mortality rate of 70%. They concluded that mourning doves generally have 3 successful broods from 5 to 6 nesting attempts, produce 1.7 young per nest attempt, and average 5.1 young per breeding pair. The U.S. Fish and Wildlife Service (1977) estimated from wing collections in the Eastern Management Unit that 5.0 immatures per adult pair were required to maintain the population with 62% mortality. The production rates in this study (1.7 and 1.9 young per adult pair) were far below the productivity requirements of the Southeastern Game and Fish Commissioners (1957) and the U.S. Fish and Wildlife Service (1977). The low productivity in this study resulted from the low number of nest attempts per pair (2.8 and 3.9) and low nesting success (35.3% and 32.3%).

IV. Nesting Habitat

Habitat Utilization

Mourning doves utilize a variety of sites for nesting. Adaptability of the species is reflected in its extensive range (Hanson and Kossack 1963). Nesting habitat for the mourning dove in this area is predominantly edge. Wooded fencerows were the most important habitat type with 20 nests (41.7%) occurring in this habitat type on the study area. On his rural area in Loudon County, Tennessee, Burch (1982) reported that 72.2% of all nests occurred in wooded fencerows. Although wooded fencerows are clearly important to nesting mourning doves, it could not be considered preferred habitat as it was the most commonly searched habitat type on the study area.

Hopkins and Odum (1953) noted the location of "traditional" spots on their study area which were used more frequently than other apparently similar locations. One such "traditional" area was observed in this study. Nests were consistently found in this location both years of the study.

Selection of Nest Sites

Eastern redcedar was the species most commonly used as a nesting site. Honeylocust and hackberry were important deciduous species. Thirteen nests (76.5%) and 16 nests (51.6%) were built in these 3 tree species in 1979 and 1980, respectively. Burch (1982) reported that hackberry and eastern redcedar were the tree species most commonly used as nesting sites on his rural area in Loudon

County, Tennessee. Honeysuckle was often associated with a nest tree and in some cases completely covered the tree. Burch (1982) speculated that the presence of honeysuckle may have influenced the selection of a nest site and deciduous trees may have been used less in its absence.

Many authors have observed doves nesting in previously constructed nest structures (Nice 1922, Monk 1949, and Hanson and Kossack 1963). There were 2 instances of mourning doves nesting in pre-existing dove nests in 1979 and 1980. There were also 2 instances of mourning doves utilizing nests of other species in 1980. The low incidence of secondary use of nest structures is probably characteristic of rural nesting habitat where nesting sites are abundant and breeding density is relatively low. Burch (1982) reported that 24 nests (24.2%) on his urban area occurred in previously constructed nests while only 1 nest (2.9%) on his rural area occurred in a previously constructed nest structure. He speculated that the difference in secondary usage of pre-constructed nests between his urban and rural study areas was primarily due to the availability of preconstructed nest structures on his urban area.

CHAPTER VI

SUMMARY

1. A total of 48 mourning dove nests was found on the study area, 17 during 1979 and 31 during 1980.
2. Courtship activity was observed in early February in 1979 and 1980. The beginning of the nesting season was marked by the initiation of the first nest. The first nests were initiated 24 March 1979 and 22 March 1980.
3. Nest initiation peaked in April in 1979 and 1980. Sixteen of the 17 nests located in 1979 were initiated by the end of June. The last nest was initiated 3 August 1979. In 1980, 20 nests (64.5%) had been initiated by June. The last nest was initiated 5 September 1980.
4. All nests for which clutch size was known contained 2 eggs. A total of 34 eggs was laid in 1979; 13 eggs (38.2%) hatched. In 1980, 59 eggs were laid and 33 (60.0%) hatched.
5. The first young fledged the nest 22 April 1979 and 26 April 1980. The peak in fledgling production occurred in May 1979 and September 1980. The last young fledged the nest 7 June 1979 and 24 September 1980.
6. The proportion of annual recruitment occurring after 1 September varied widely between years. In 1979, no young were recruited after 1 September, while in 1980, 5 young (33.3%) were recruited after 1 September.

7. To circumvent overlap between nesting and hunting seasons, the earliest opening date for a dove hunting season would be 1 October, based on data generated in this study.

8. The nesting season spanned 142 days in 1979 and 185 days in 1980.

9. A nest was considered successful if at least 1 young fledged. In 1979, 6 nests (35.3%) were successful, all occurring within the first half of the season (March-June). In 1980, 10 nests (32.3%) were successful. Three nests were successful in the first half of the season and 7 nests were successful in the last half of the season (July-September).

10. Predation and weather were thought to be important causes of nest destruction but the cause of most nest losses was recorded as unknown due to the lack of evidence at the nest site. Crows, bluejays, opossums, and black rat snakes were abundant predators on the study area. Two nests were lost to predators in 1979 and 3 nests were preyed upon in 1980. Bad weather destroyed 4 nests in 1979 and 1 nest in 1980. Two nests failed because of human disturbance and 2 nests were deserted in 1980.

11. There was a minimum of 6 breeding pairs on the study area in 1979 and 8 pairs in 1980. The breeding density was 0.4 and 0.6 breeding pairs per 20 ha in 1979 and 1980, respectively. The nesting density was 1.3 nests per 20 ha in 1979 and 2.4 nests per 20 ha in 1980.

12. Mourning doves made 2.8 nest attempts per pair in 1979 and 3.9 nest attempts per pair in 1980. The fledgling production was

0.6 young per nest attempt and 1.7 young per breeding pair in 1979. Production was 0.5 young per nest attempt and 1.9 young per breeding pair in 1980.

13. Production density was 0.7 young per 20 ha in 1979 and 1.1 young per 20 ha in 1980.

14. All nests were located in 3 habitat types, wooded fencerows, clumped trees, and isolated trees. Twenty nests (41.7%) were located in wooded fencerows with an equal proportion (29.2%) occurring in isolated and clumped trees.

15. Eastern redcedar, hackberry, and honeylocust were most commonly used as nesting sites. Thirteen nests (76.5%) were located in these 3 species in 1979 and 16 nests (51.6%) were built in these species in 1980.

16. Nest height ranged from 1.2 to 7.5 m, with a mean of 3.0 m. The height of dominant vegetation ranged from 2.7 m to 15 m, averaging 7.4 m.

17. There were 2 instances of mourning doves nesting in nest structures previously constructed by mourning doves in 1979 and 1980. There were also 2 instances of doves nesting in nest structures built by other species in 1980.

LITERATURE CITED

LITERATURE CITED

- Burch, M. S. 1982. Nesting ecology of mourning doves in Knox and Loudon Counties, Tennessee. M.S. thesis, Univ. of Tenn., Knoxville. 83 pp.
- Caldwell, L. D. 1955. A nesting study of the mourning dove in Kalamazoo County, Michigan. M.S. thesis, Mich. State Univ., East Lansing. 44 pp.
- . 1964. Dove production and nest selection in southern Michigan. J. Wildl. Manage. 28(4):732-738.
- Cole, L. J. 1933. The relation of light periodicity to the reproductive cycle, migration, and distribution of the mourning dove (Zenaidura macroura carolinensis). Auk 50:284-295.
- Fichter, E. 1959. Mourning dove production in four Idaho orchards and some possible implications. J. Wildl. Manage. 23(4):438-447.
- Hammond, J. W. 1954. The mourning dove in Tennessee. Final Report, Project W-11-R. Tennessee Game Fish Comm. 39 pp.
- Handly, R. B., and W. R. Edwards. 1957. Mourning dove nest studies in Mississippi. Proc. Southeast Assoc. Fish Game Comm. 11:38-45.
- Hanson, H. C., and C. W. Kossack. 1963. The mourning dove in Illinois. Illinois Dept. Conserv. Tech. Bull. No. 2. 133 pp.
- Harris, S. W., M. A. Morse, and W. H. Longley. 1963. Nesting and the production of the mourning dove in Minnesota. Am. Midl. Nat. 69(1):150-172.
- Hopkins, M. N., and E. P. Odum. 1953. Some aspects of the population ecology of breeding mourning doves in Georgia. J. Wildl. Manage. 17(2):132-143.
- Lowe, J. I. 1956. Breeding density and productivity of mourning doves on a county-wide basis in Georgia. J. Wildl. Manage. 20(4):428-433.
- Lund, J. V. 1952. Nesting activities of the eastern mourning dove in southern Michigan. M.S. thesis, Mich. State Coll., East Lansing. 54 pp.

- McClure, H. E. 1942. Mourning dove production in southwestern Iowa. *Auk* 59(1):64-75.
- _____. 1950. An eleven year summary of mourning dove observations in the west. *Trans. N. Am. Wildl. Nat. Resour. Conf.* 15:335-346.
- Monk, H. C. 1949. Nesting of the mourning dove at Nashville. *Migrant* 20(1):1-9.
- Moore, G. C. 1940. The nesting habits and juvenile development of the mourning dove in Alabama. M.S. thesis, Ala. Polytech. Inst., Auburn. 65 pp.
- National Oceanic and Atmospheric Administration. 1979-80. Local climatological data, monthly summaries: Knoxville, Tennessee. Nat. Climatic Center. Asheville, N.C.
- Nice, M. M. 1922-23. A study of the nesting of mourning doves. *Auk* 39(4):457-474; *Auk* 40(1):37-58.
- Pearson, A. M., and G. C. Moore. 1939. Nesting habits of the mourning dove in Alabama. *Trans. N. Am. Wildl. Nat. Resour. Conf.* 4:468-473.
- _____. and W. Rosene, Jr. 1938. Observations on the breeding season of the mourning dove in the south. *Trans. N. Am. Wildl. Nat. Resour. Conf.* 3:865-878.
- Quay, T. L. 1951. Mourning dove studies in North Carolina. Federal Aid in Wildlife Restoration Projects 2-R and 26-R. North Carolina Wildl. Resources Comm., Raleigh. 90 pp.
- Roberts, W. 1955. Soil survey of Knox County, Tennessee. U.S. Dept. Agric., Soil Conserv. Ser. Series 1942, No. 10. 241 pp.
- Schroeder, M. H. 1970. Mourning dove production in a Kansas osage orange planting. *J. Wildl. Manage.* 34(2):344-348.
- Soileau, L. D. 1960. Eastern mourning dove production in Roselawn Cemetery, Baton Rouge, Louisiana. M.S. thesis, La. State Univ., Baton Rouge. 38 pp.
- Southeastern Association of Game and Fish Commissioners. 1957. Mourning dove investigations 1948-1956. S.E. Assoc. Game and Fish Comm., Columbia, S.C. 166 pp.

- Sprunt, A., IV. 1957. The seasonal population and nesting success of the mourning dove in Virginia. M.S. thesis, Va. Polytech. Inst., Blacksburg. 60 pp.
- Swank, W. G. 1955. Nesting and production of the mourning dove in Texas. *Ecol.* 36(3):495-505.
- Taylor, M. H. 1941. Breeding and nesting activities of the eastern mourning dove in North Carolina. M.S. thesis, North Carolina State Univ., Raleigh. 81 pp.
- United States Fish and Wildlife Service. 1977. Proposal for continuation of September hunting of mourning doves. Environmental Assessment. U.S. Dept. Interior. 42 pp.
- Welty, J. C. 1962. The Life of Birds. W. B. Saunders Company, Philadelphia and London. 546 pp.

APPENDIX

VITA

Elizabeth S. Stogsdill was born in Camden, South Carolina, on 18 December 1956. She is the daughter of Bentley Richard Stogsdill, Jr. and Lorine S. Stogsdill.

Miss Stogsdill graduated from Joseph Kershaw Academy, Camden, South Carolina in 1974. She entered The University of the South, Sewanee, Tennessee in August 1974 and received a Bachelor of Science degree in Biology in 1978. The author entered The University of Tennessee, Knoxville, in September 1978 and accepted a research assistantship with the Department of Forestry, Wildlife and Fisheries. She received the Master of Science degree in Wildlife and Fisheries Science in December 1983.

She is married to James S. Pentecost, Jr.