DISTRIBUTION AND BREEDING CHRONOLOGY OF WOODCOCK IN TENNESSEE

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Abstract: Woodcock (*Philohela minor*) singing grounds were located in 39 counties in Tennessee. Harvest records indicated that the Great Valley and the Central Basin were the most productive hunting areas during 1966-1976. During 1977 and 1978 February hunting seasons, western Tennessee hunters contributed about one-third of all woodcock. Spring migration through Tennessee occurred from mid February to mid March both years of the study. Testes of males shot during February averaged 9.2 mm in length both years (n = 20, 1977, n = 46, 1978). Follicle measurements of females collected during February showed a wide variation in degree of sexual maturation. Clutch and brood observations in 1978 indicated that peak nesting occurred during the second and third wks. in March.

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Woodcock occur in Tennessee as spring and fall migrants, and as breeding residents. In mild winters, some birds may also remain as winter residents. Available information precludes precise delineation of the proportion of the population distributed in these various groups.

Traditionally, the woodcock has been a game bird of only minor importance in the Southeast. Little effort had been made until recently to determine the regional status of the species in regard to its distribution and the extent and chronology of breeding. Glasgow (1958) stated that he observed males in courtship flight in early December in Louisiana. Causey et al. (1974) documented concentrations of breeding woodcock in Alabama and demonstrated that nesting in February is fairly common. Stamps and Doerr (1977) provided evidence that testicular recrudescence occurs as early as December in North Carolina, noting also that a large percentage of females collected during February were in advanced stages of reproductive maturation. Kletzly (1976) stated that males usually begin courtship flights from mid to late February in West Virginia. In Kentucky, male woodcock have been observed performing courtship flights as early as 3 February (Russell 1958). Taylor (1976) stated that singing males were already numerous on 19 February in Virginia, the first date that Virginia census routes were run in 1975.

Tennessee's woodcock hunting season is currently split into 2 parts, the late season running from 1-28 February. Considering that woodcock breeding activity begins at such an early time in several bordering states, it was deemed desirable to determine the reproductive status of woodcock in Tennessee during late winter.

This study was initiated in 1976 to delineate the seasonal and geographic distribution of woodcock and to define the chronology and extent of breeding that occurs in Tennessee. The geographical distribution and spring migration of woodcock through Tennessee, and the reproductive status of woodcock collected in the winters of 1976-77 and 1977-78 are discussed.

We wish to thank the county wildlife officers and other personnel of the Tennessee Wildlife Resources Agency (TWRA) for their invaluable assistance in locating suitable woodcock habitat, for providing records of woodcock nests and broods, and for assisting with woodcock collections during the 1977 and 1978 February hunting seasons. Members

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of the Tennessee Ornithological Society (TOS) supplied valuable records of woodcock observations and the locations of singing grounds. We thank M. Bierley, W. Coffey, D. Pitts, G. Roberts, and M. Williams for their notes on woodcock observations. Numerous undergraduate and graduate students helped with the study. Special thanks are extended to L. Marcum for his time and assistance and to the sportsmen of Tennessee (especially F. Harlow, T. Lewis, T. Lindsey, and L. Longerbeam) for their many contributions. The study was supported by the U.S. Fish and Wildlife Service in cooperation with the Tennessee Wildlife Resources Agency and the University of Tennessee Agriculture Experiment Station.

METHODS

Distribution

The distribution of singing grounds located during this study, harvest data from Tennessee summarized by Marcum (1977), and woodcock harvested for this study were used to delineate the geographic distribution of woodcock in Tennessee.

Members of the TOS, county wildlife officers, TWRA biologists, and other interested persons were asked to locate singing grounds in their home county or region. Several major Tennessee newspapers carried articles requesting information on the location of singing grounds.

Woodcock were collected by hunting with pointing dogs during February 1977 and 1978. Efforts were also made in 1978 to collect woodcock during January and March. County wildlife officers were asked to collect carcasses from woodcock hunters or from quail (*Colinus virginianus*) or ruffed grouse (*Bonasa umbellus*) hunters who occasionally killed woodcock. Hunters were requested to furnish the date and location for each bird killed.

Harvest data were based on the annual woodcock wing survey conducted by the U.S. Fish and Wildlife Service, woodcock wings submitted during a TWRA quail study, and a mail survey of woodcock hunters in Tennessee conducted by the TWRA in 1974.

Spring Migration

Beginning in early January both years of the study, areas known to be used as singing grounds were regularly checked to determine the onset of spring migration. Selected areas containing several singing grounds were monitored throughout the breeding season to define the peak and duration of migration and breeding activity in Tennessee.

Hunter reports, solicited by county wildlife officers, were also used to help delineate the chronology of migration. Some hunters who had demonstrated an interest in the study were contacted by telephone during January and February of both years.

Gonad Development

All birds were sexed and aged externally according to characteristics of the primaries and secondaries (Martin 1964). Gonads from woodcock collected during February 1977 and 1978 were examined to determine the extent of sexual maturation. The length and width of the testes and the diameter of ovarian follicles were measured to the nearest 0.1 mm with small dial calipers.

Nests and Broods

Pointing dogs were used to locate nests and broods. Two days were spent searching coverts located near occupied singing grounds in March 1977 in Cumberland, Anderson, and Knox counties. More intensive searches were conducted during March and April 1978 in Knox, Bradley, Cumberland, Henderson, Fayette, and Shelby counties. Flightless chicks were captured by hand, aged according to bill length (Ammann 1967), banded, and released near the point of capture. No attempts were made to capture hens

found with the broods. One clutch was aged according to the floatation method described by Ammann (1967). The approximate hatching date for some broods found by cooperators was determined by estimating the age of chicks from the description given by the observer.

RESULTS AND DISCUSSION

Distribution of Woodcock in Tennessee

Singing grounds were located in 39 counties, representing all 8 physiographic regions of the state (Fig. 1). Some of these singing grounds were occupied only briefly by birds believed to be transients, but many were occupied for several weeks, probably by males on

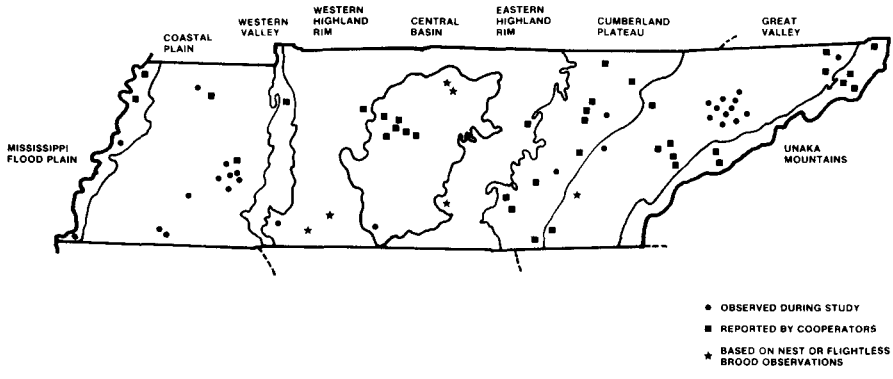

Fig. 1. Distribution of woodcock singing grounds in Tennessee, 1977 and 1978.

established breeding territories. The absence of singing grounds from the remaining counties probably reflected insufficient field work in those areas. The most significant interpretation is that woodcock singing grounds, both transitory and permanent, are widespread across Tennessee during late winter and spring.

Harvest records summarized by Marcum (1977) also showed that woodcock are widely distributed over the state during fall and early spring. The Great Valley, especially the southern half, and the Central Basin generally reported high kills while those from the Eastern Highland Rim and the Unaka Mountains were consistently low. Due to small sample sizes and different methods for calculating annual harvests, these data may not accurately depict the regional woodcock populations in Tennessee. The reported woodcock harvest in Tennessee is often so small ($n < 100$) that a group of interested hunters or even an individual hunter could significantly affect the proportionate harvest attributed to a particular region.

A total of 156 woodcock collected by us or contributed by hunters for this study was used to estimate the proportion harvested in western (Western Valley, Coastal Plain, and Mississippi Flood Plain), central (Eastern and Western Highland Rim, Central Basin, and Cumberland Plateau), or eastern (Green Valley and Unaka Mountains) Tennessee. The percentage harvest from western Tennessee in both years (37 and 35%) was considerably higher than estimated by Marcum (1977) for previous years. This distribution of harvest more closely reflected the expected distribution based on the proportion of westland habitat in each of the 3 divisions. The very low February harvest for eastern Tennessee in 1977 (7%) was probably due to low hunting effort. Woodcock were frequently observed near Knoxville during the last 2 weeks in February, indicating that the low harvest did not necessarily reflect a scarcity of birds.

Observations of male woodcock on singing grounds (Fig. 1) and harvest data showed that woodcock are widely distributed across Tennessee. Both sets of data suggested that woodcock are most common in the Great Valley, portions of the Cumberland Plateau, the Central Basin, and throughout western Tennessee. Few woodcock were reported from the northern Cumberland Plateau, the Eastern and Western Highland Rim, and the Unaka Mountains, and it is likely that these areas have the lowest woodcock densities in the state during migration and during the breeding season.

Spring Migration

1977 – Courting males were first observed near Knoxville (eastern Tennessee) on 19 February. Courtship flights were also first reported in western Tennessee on 19 February. Near Nashville (central Tennessee) woodcock were first heard singing on 24 February.

No field studies were conducted near Knoxville during the last 10 days of February but it is likely that peak migration occurred in late February or early March. Counts of singing males near Knoxville showed that most migrants had passed through that area by 12 March. For example, the number of singing males on 2 areas declined from 5 and 3 respectively to 1 during the second week in March. Cooperators in western Tennessee observed a similar chronology.

Wildlife officers and hunters reported that few woodcock were harvested before mid February. Some small concentrations of woodcock were observed in western Tennessee during January and early February; woodcock were flushed throughout the winter by hunters near Memphis, but apparently few woodcock wintered elsewhere in Tennessee. The distribution of the harvest likewise showed that woodcock were most numerous in February during the last week of the month with 91.4% (n = 58) of the birds harvested for this study taken during that period.

1978 – Woodcock were reported regularly from several areas of the state throughout December 1977 and early January 1978. Sub-freezing temperatures prevailed from about 10 January until the second week in February, apparently causing mass emigration of woodcock. Intensive searches of coverts which harbored birds the previous winter suggested that few, if any, woodcock were in Tennessee during this period.

Hunters first reported seeing woodcock the second week in February and by 20 February woodcock were reported from many areas of the state. Of 88 woodcock collected in February, 68.2% were killed the last 7 days of the month.

The appearance of birds on singing grounds indicated that spring migration through eastern Tennessee began the third week in February. Males were first observed singing near Knoxville on 17 February, and peak numbers occurred from the end of February through the second week in March (Fig. 2). A cold period early in March may have delayed some migrants from moving up through the state during this period. In eastern Tennessee most migrants had departed by 20 March. Observers in western Tennessee reported that migration began 4-5 days later but that otherwise the chronology was much the same.

Sheldon (1967) noted that the severity of weather in January and February governs, to a large extent, the time when woodcock begin their spring migration. Both years of this study were characterized by abnormally severe weather; thus, the chronology of migration observed in 1977 and 1978 may not be representative of normal years. Records in the TOS bulletin, *The Migrant*, showed that during some years woodcock are present in Tennessee throughout December, January, and February. Whether these wintering birds are locals, migrants which have stopped short of traditional wintering grounds, early spring migrants, or some combination has not been determined.

It is speculated that some portion of the woodcock present in Tennessee after mid January may be early spring migrants. Glasgow (1958) stated that in mild winters most

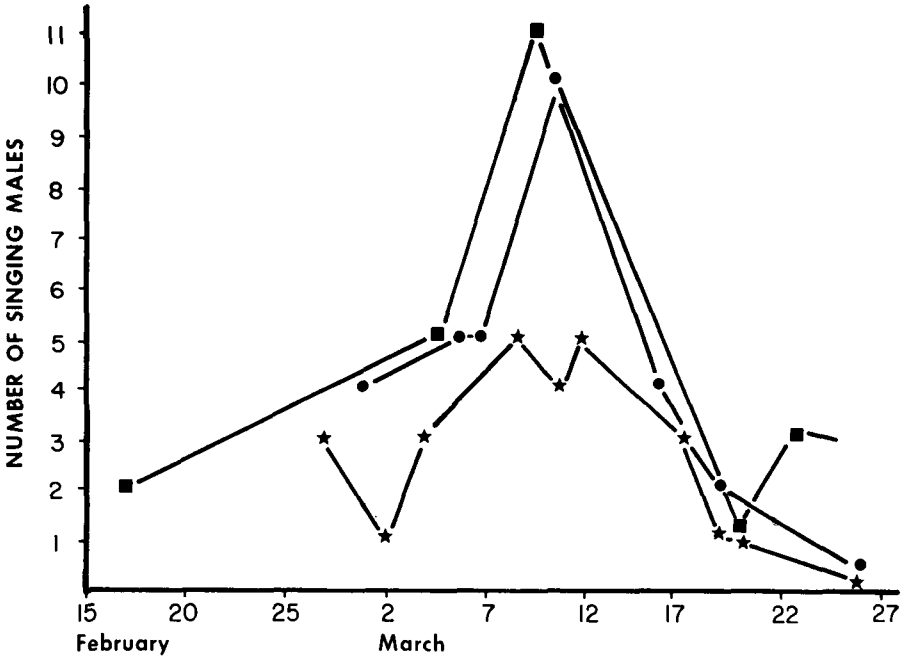

Fig. 2. Numbers of male woodcock displaying on 3 singing grounds in east Tennessee during February and March, 1978.

woodcock had departed from Louisiana by 1 February, in normal winters by 12 February, and in cold winters by 28 February. Harvest figures suggested that woodcock leave northeastern Georgia by late January (Pursglove 1974). Kletzly (1976) stated that during most years male woodcock reach southern West Virginia by early February. Hunter surveys in North Carolina suggested spring migration begins about mid January in western North Carolina (Stamps and Doerr 1977). Thus, in some years, spring migration through Tennessee may begin 3 to 4 weeks earlier than was observed during this study although it is likely that peak flights do occur in late February or early March.

Reproductive Status

Measurements of gonads were obtained from 113 woodcock. Length of the left testis was measured for 66 males. The diameter of the single largest ovarian follicle was measured for 27 females in 1977 and measurements of several of the largest ovarian follicles were taken for 20 females collected during 1978.

Males—All males collected during February or March contained enlarged testes and were assumed to be sexually mature. Since only a few woodcock were collected before mid February either year we could not determine when testis enlargement began. Testes lengths of February shot males were similar both years, averaging 9.2 mm ($n = 20$, 1977, and $n = 46$, 1978).

Marshall (1959) stated that in many species of birds testicular recrudescence is accompanied by territory selection, song, and increasingly intensive sexual activity. In Tennessee, male woodcock were observed performing courtship flights as early as 14 December 1977 near Nashville. Sporadic courtship was also observed in late December 1977 and early January 1978 near Chattanooga and Knoxville. The severe weather during

January halted courtship and apparently forced most woodcock to emigrate from Tennessee. Courtship displays were not observed throughout this period until spring migration began in mid February.

Courtship flights in December and January are not uncommon in Tennessee, suggesting that at least during some winters gonadal enlargement in male woodcock occurs as early as December. Since all males that were examined had enlarged testes, reproductive maturation apparently is completed no later than mid February. Courtship performances observed in February 1977 and 1978 when woodcock first returned to Tennessee did not differ noticeably in duration or intensity from those observed later during peak breeding activity.

Marshall (1961) noted that gonad development is influenced by a number of factors, temperature being one of the more important. Most of the early courtship flights reported by various researchers have been observed during periods of unseasonably mild weather, suggesting that warm temperatures may be a factor enhancing testicular recrudescence in woodcock. Additional work during more moderate winters is needed to determine the effects that yearly weather variation has on the chronology of reproductive maturation of male woodcock in Tennessee.

Females – Measurements of the ovarian follicles showed that the degree of sexual maturation varied widely among females (Table 1). The diameter of the single largest ovarian follicle ranged from 1.5 mm to one of 23.3 mm in a female with a shelled egg in the lower oviduct.

Table 1. Diameter of largest ovarian follicles from woodcock collected in Tennessee in February, 1977 and 1978.

Diameter class (mm)	*1977*		*1978*	
	No.	*(%)*	*No.*	*(%)*
< 2.1	5	(19)	0	(0)
2.1-3.0	4	(15)	3	(15)
3.1-4.0	6	(22)	6	(30)
4.1-5.0	3	(11)	8	(40)
> 5.0	9	(33)	3	(15)
Total	27	–	20	!

Since eggs are produced in succession, the ova differ in relative maturity and size. During the final phase of growth, layers of yolk are deposited rapidly and after the oocyte reaches a threshold point the rate of growth accelerates rapidly. For example, in domestic hens (*Gallus gallus*) the diameter of the yolk increases from 6 mm to 35 mm in just 6 days (Romanoff and Romanoff 1949).

As woodcock were not collected in January or early February, we could not determine when ovarian maturation began. Stamps and Doerr (1977) arranged follicles in order of decreasing size to determine the growth intervals between successive follicles. Their data suggested that follicles greater than 4 mm in diameter were in the final rapid growth phase of ovarian maturation, and that females with follicles of that size were rapidly approaching nesting.

Assuming that a follicle diameter of 4 mm defines the point at which follicular growth accelerates, then 44% of the females collected in February 1977 and 52% of the females collected during February 1978 would have begun nesting in a short time. An examination of 5 gravid females suggested that rapid acceleration of follicular growth

begins after the follicle reaches a size greater than 5 mm (Fig. 3), but more work is needed to determine precisely at what point final rapid growth does begin.

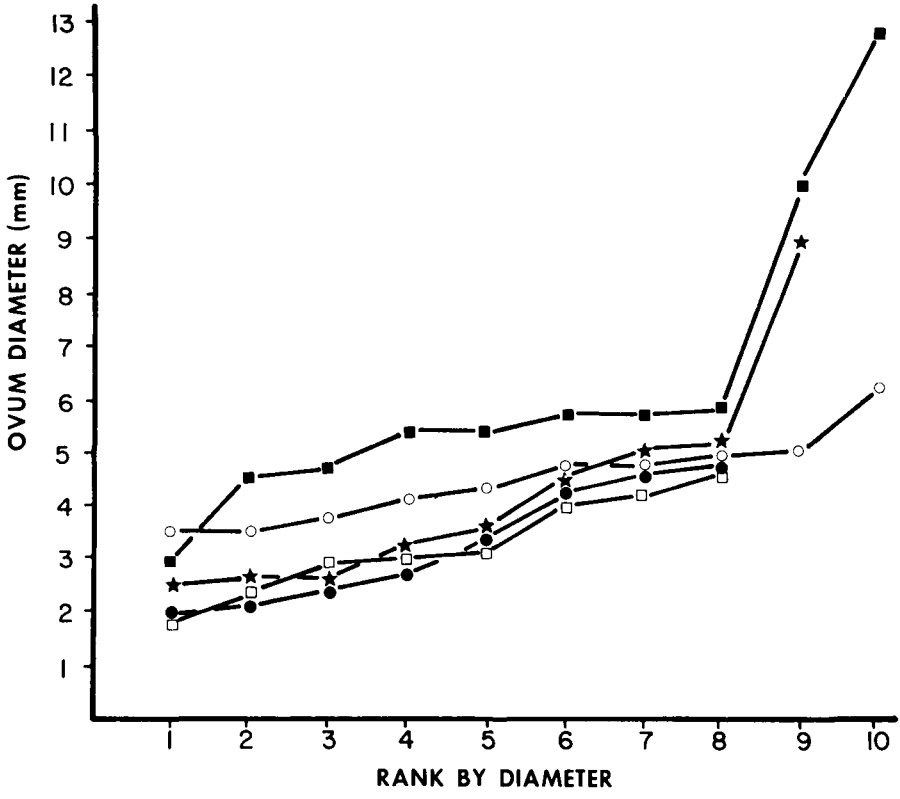

Fig. 3. Diameters of largest ova (mm) in 5 woodcock shot during February, 1978.

The chronology of nesting observed in 1978 also indicated that laying and incubation may not begin for some time after follicles reach the 4-5 mm stage. One female collected on 17 February, 3 females collected on 18 February, and several females shot during the last week in February all contained enlarged follicles, yet the earliest clutch or brood that was located was estimated to have been started on 7 March.

Marshall (1961) stated that the gonads of migratory birds are active when they leave their wintering grounds, but added that although the birds are physiologically prepared for reproduction, certain stimuli such as behavioral interactions, territory, traditional breeding grounds, and a suitable nesting site, among others, might be necessary before nesting actually takes place. It seems likely that this is the case with woodcock, but the factors that initiate nesting behavior are as yet incompletely understood.

Chronology of Nesting

Seven nests and 11 broods were located during March and April 1977 and 1978 (Table 2). Clutches or broods were located in all physiographic regions except the Unaka Mountains and the Eastern Highland Rim indicating that woodcock breeding is

Table 2. Chronology of reproduction for woodcock in Tennessee, 1978, based on 14 broods or clutches located during this study.

Event	*Date*
Earliest nest initiated	7 March
Latest nest initiated	17 March
First nest hatched	1 April
Last nest hatched	11 April
Approximate period of fledging	16-27 April

widespread over Tennessee. In 1978 the earliest clutch was initiated 7 March, but most were begun during the second and third week in March. Sample size was much too small to estimate chronology of nesting in 1977.

The date that nesting began could not be determined for some of the clutches or broods reported by cooperators. Approximately 8-10 additional broods were located 22 April 1978 by TWRA biologists. All the chicks were flightless (less than 14 days old).

In Tennessee, clutches have been reported as early as the last of February and as late as 27 April, but records in *The Migrant* suggest that peak nesting occurs from early to mid March. Our data support this, but there are few nesting records for Tennessee and since intensive searches had never been conducted until this study it is not known whether these records accurately portray nesting chronology.

Although no clutches were found in February of either year, ovarian maturation was evident in a large proportion of the females and eggs were found in females that were shot near the end of February. Woodcock have been observed nesting in January or February in Arkansas and Georgia (Pettingill 1936), Alabama (Causey et al. 1974), and North Carolina (Stamps and Doerr 1977), and it is speculated that in mild winters some nesting may occur as early as mid February in Tennessee.

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