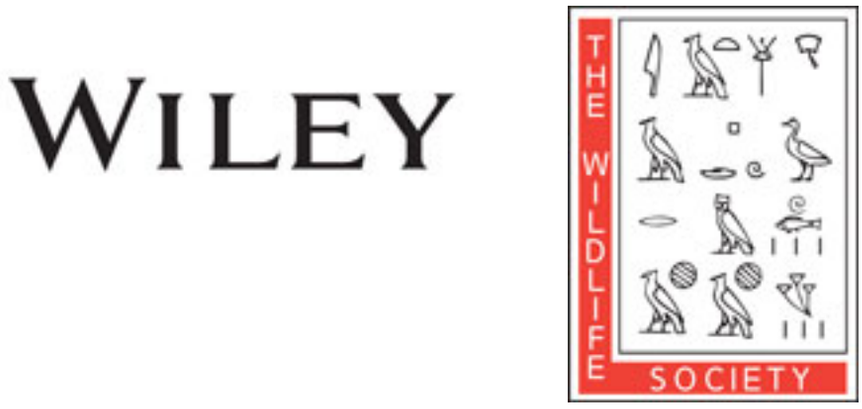

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GONADAL CHARACTERISTICS OF FEBRUARY-HARVESTED WOODCOCK IN LOUISIANA

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Since 1970 a number of investigations on the reproductive condition of American woodcock (*Scolopax minor*) during the hunting season have been conducted in the southern U.S., with particular emphasis on evaluating the potential effects of February hunting on the population (e.g., Stamps and Doerr 1977, Roberts and Dimmick 1978, Pace and Wood 1979, Roboski and Causey 1981, and Whiting et al. 1985). Louisiana, which allows February hunting, is the only southern state where the woodcock is considerd a major game bird, at least as measured by hunter harvests (Migr. Bird Manage. Off., Laurel, Md., unpubl. file data). However, data on woodcock reproductive chronology in Louisiana are limited. We measured follicular and testicular characteristics to assess the breeding condition of woodcock shot in Louisiana during the February hunting season.

METHODS

Woodcock were collected statewide by Louisiana Department of Wildlife and Fisheries personnel and volunteers from 1 February through 10, 15, and 14 February for 1980, 1981, and 1982, respectively. Legal hunting was the primary method of collection (>97%). All specimens were frozen until processed. We measured the diameter of the largest ovarian follicle or the length of the left testis (nearest 0.1 mm) with vernier calipers. We also noted the presence or absence of eggs in the oviduct.

Ovarian follicles ≥5.0 mm in diameter were considered to indicate females in or approaching breeding condition (Whiting et al. 1985). Roberts (1980) reported that 76% of male woodcock with left testis lengths ≥6.0 mm contained spermatazoa in all seminiferous tubules. Thus, we considered males with testes lengths ≥6.0 mm to be in or approaching breeding condition. We aged birds using plumage characteristics (Martin 1964).

The state was divided into regions roughly at latitude 31° North. The southern region is an area where woodcock hunting has traditionally occurred; whereas, we believe much of the harvest of woodcock in the northern region is incidental to quail, rabbit, and other types of hunting.

Analyses of variance were performed to assess differences in the proportions of woodcock in or approaching breeding condition among years and between regions and ages. The analyses were based on the arcsin square root transformation of the proportions (Snedecor and Cochran 1967: 327–330), using the number of birds to estimate each proportion as weighting factors and years as replicates. Statistical analyses were conducted only with birds for which data on both age and stage of gonadal development were available. Sexes were analyzed separately.

RESULTS

Gonadal Characteristics

Gonadal stage and age were determined for 638 woodcock (Table 1). Except for 7 February 1982, at least 1 bird was obtained each day during the collection period; collections were obtained from 24 parishes. Males in the sample totaled 262 (41.1%) and the left testis measured ≥6.0 mm in 242 (92.4%). Yearly percentages of woodcock with left testicular measurements ≥6.0 mm were 88.0% (n = 50), 93.1% (n = 145), and 94.0% (n = 67) for 1980, 1981, and 1982, respectively, and did not differ among years or between regions and ages (Table 2).

In contrast to the high percentage of males in reproductive condition, only 2.4% of the females (n = 376) contained ovarian follicles ≥5.0 mm. The proportions among years were similar (F = 4.36, 1,11 df, P = 0.07). The percentages of females with follicles measuring ≥5.0 mm were 5.9% (n = 85), 1.1% (n = 188), and 1.9% (n = 103) for 1980, 1981, and 1982, respectively. Two of 26 unaged females collected in 1980, both from the northern region, also had follicles ≥5.0 mm. The earliest date of collection for a female with a follicle

Table 1. Proportion of woodcock in or approaching breeding condition[a] (i.e., active) by sex, age, and region for 638 woodcock collected in Louisiana during February hunting 1980–1982.

		Female				Male			
		North		South		North		South	
Year	Age	Proportion active	*n*	Proportion active	*n*	Proportion active	*n*	Proportion active	*n*
1980	Adult	0.167	18	0.031	32	1.000	2	0.857	21
	Subadult	0.143	7	0.000	28	1.000	8	0.842	19
1981	Adult	0.053	38	0.000	71	0.957	23	0.929	28
	Subadult	0.000	23	0.000	56	0.919	37	0.930	57
1982	Adult	0.074	27	0.000	24	1.000	12	0.909	11
	Subadult	0.000	21	0.000	31	1.000	15	0.897	29
All years	Adult	0.084	83	0.008	127	0.973	37	0.900	60
	Subadult	0.020	51	0.000	115	0.950	60	0.905	105

[a] Females with ovarian follicles ≥5.0 mm in diameter; males with testes lengths ≥6.0 mm.

≥5.0 mm was 1 February. Only 1 (0.2%) specimen had an egg in the oviduct and this woodcock was collected on 1 February 1980. Another woodcock collected on 6 February 1982 had a greatly enlarged uterine tract but did not have an egg in the oviduct. No nests were observed during any of the collections. Females with follicles ≥5.0 mm were more abundant (F = 13.86, 1,11 df, P = 0.01) in the northern region (6.0%, n = 134) than in the southern region (0.4%, n = 242), and a greater proportion of adults (8.4%, n = 210) than subadults (0.6%, n = 166) displayed advanced gonadal recrudescence (F = 10.29, 1,11 df, P = 0.02).

DISCUSSION

The extent of gonadal development in male woodcock collected in this study was similar to that reported for February by Stamps and Doerr (1977), Roberts (1980), Rushing and Doerr (1984), and others. The significance of harvesting males capable of reproduction is not known, but due to the polygamous nature of woodcock, it is generally thought that the harvest of such males in February will have little impact. Whiting et al. (1985) did express some concern for harvesting dominant males. However, the practice of looking for singing males to determine hunting sites is not thought to be common in Louisiana.

Greater concern over the harvest of female woodcock in February has been expressed in light of several breeding condition studies. Data from Whiting et al. (1985) show that 21% (n = 304) of the females collected during February 1977–1983 in 5 southern states, primarily Alabama, Tennessee, and Texas, had follicles ≥5.0 mm. Roberts and Dimmick (1978) found that 26% (n = 47) of females taken in Tennessee during mid- and late February in 1977 and 1978 had follicles >5 mm. Stamps and Doerr (1977) found 6 of 12 females with follicles ≥5.0 mm during February collections in North Carolina in 1974 and 1975.

We found the percentage of females showing this advanced ovarian recrudescence in February (2.4%) to be lower than that reported

Table 2. Analyses of variance for factors influencing gonadal development of woodcock collected in Louisiana during February hunting 1980–1982.

		Male		Female	
Source	df	MS	*P*	MS	*P*
Year	2	0.159	0.60	0.623	0.07
Region	1	1.265	0.08	1.981	0.01
Age	1	0.026	0.77	1.471	0.02
Region × Age	1	0.020	0.80	0.662	0.07
Error	6	0.285		0.143	

in the aforementioned studies but similar to that reported in South Carolina (Ingram and Wood 1983; R. P. Ingram, U.S. Fish and Wildl. Serv., St. Marks Nat. Wildl. Refuge, pers. commun.). They found no females with follicles ≥5.0 mm between 31 January and 14 February 1979–1981 (n = 38). Later collection dates (15–29 February) may have contributed to the higher incidence of the advanced ovarian recrudescence in females reported in other studies. However, it is unlikely that time of collection is the sole factor involved. Stamps and Doerr (1977) collected 1–18 February and reported one of the highest incidences of follicles ≥5.0 mm. Whiting et al. (1985) reported 25% (n = 60) had follicles ≥5.0 mm in woodcock collected in Texas, 1–14 February 1982. In contrast, Pace and Wood (1979) found no females with follicles ≥5.0 mm in South Carolina during February 1979 (n = 24) and 14 of these birds were collected 15–20 February.

Yearly variations in weather (number of days in January with mean daily temperatures ≥4.4 C) have been correlated to the amount of nesting occurring in Alabama (Causey et al. 1987). Stamps and Doerr's (1977) work was conducted during very mild years. In Louisiana there were 26, 22, and 23 days with mean daily temperatures ≥4.4 C in 1980, 1981, and 1982, respectively (La. State Univ. Climate Off., unpubl. files for Shreveport). The 30-year average for 1951–1980, the period currently used by the U.S. Weather Service for normal temperature calculations, is 21.5 days (SE = 1.0). As such, weather was warmer than normal in 1980 and normal in 1981 and 1982. The proportions of females with ovarian follicles ≥5 mm during these years were 5.9%, 1.1%, and 1.9%, respectively. Although the reproductive condition of females among years was similar in our study, we believe that abnormally warm weather stimulates earlier follicular development. We also believe these low values are demonstrative of the generally low incidence of woodcock nesting in Louisiana.

Scattered breeding occurs throughout northern and central Louisiana and only into part of southern Louisiana (Glasgow 1958). The occurrence of only 1 female with ovarian follicles ≥5.0 mm in the southern region versus 10 in the northern region is consistent with that pattern. Murton and Westwood (1977:352) associated *Zugunruhe* with the beginning of gonadal recrudescence. Our observed regional difference suggests that initiation of migration to breeding grounds is correlated with a woodcock's reproductive state in addition to daylength and temperature.

Glasgow (1958) suggested that woodcock follow 3 loosely defined migratory routes (the western, central, and Atlantic routes). He indicated that south-central Louisiana was the major terminus for woodcock using the western and central routes but of lesser importance as a wintering ground for birds using the Atlantic route. Martin et al. (1969) reported recoveries of woodcock banded in Louisiana, primarily south-central Louisiana, from virtually every southeastern state, including Texas, Arkansas, Mississippi, Alabama, Georgia, and South Carolina. As such, migration to and from Louisiana is probably not simply southward and northward but also eastward and westward.

Initiation of migration associated with reproductive state explains the regional difference observed in Louisiana as well as differences between Louisiana and states further along the migratory path. Data reported in Whiting et al. (1985) are consistent with this hypothesis. In 1979 no birds collected in Louisiana and Mississippi (n = 16) had ovarian follicles ≥5.0 mm. During that same year, 15% (n = 46) and 2 of 19 had follicles ≥5.0 mm in Alabama and Texas, respectively. In 1980, 5.9% of the females harvested during our study had follicles ≥5.0 mm while 44% (n = 39) were reported at that follicle stage in Alabama. Similarly, in 1982, 1.9% had follicles ≥5.0 mm in our study while 25% (n = 60) were at that

reproductive state in Texas. In all these instances, states further along the migratory path had substantially higher incidences of females with follicles ≥5.0 mm.

When some migratory birds leave the wintering grounds, their gonads are active. However, while physiologically ready to nest, other factors such as presence on traditional breeding ground, behavioral interaction, or territorial establishment may be necessary for nesting to be initiated (Marshall 1961:307–332). Roberts and Dimmick (1978) believed this was true for woodcock. Causey et al. (1987) suggested that woodcock begin breeding from the Gulf Coast to the northern breeding grounds as temperature allows. We believe that inconsistent nesting in the deep south related to temperature variation in combination with regional differences in reproductive condition suggest that a discrete southern population of woodcock does not exist. Rather, in many instances, temperature and physiological condition promote nesting by woodcock along the migratory path.

CONCLUSIONS

Hunting woodcock in Louisiana until 15 February resulted in the harvest of a very small proportion of female woodcock with ovarian follicles ≥5.0 mm. The mean incidence in Louisiana during the hunting season (2.4%) is much lower than most of the February values reported for other southern states. Because Louisiana accounted for approximately 75% of the total woodcock harvest by waterfowl hunters from states having February seasons during 1977–1982 (Migr. Bird Manage. Off., Laurel, Md., unpubl. files), the potential hunting mortality of female woodcock in or approaching breeding condition on the southern portion of the species range may have been overestimated.

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WHEAT STUBBLE AS NESTING COVER FOR RING-NECKED PHEASANTS IN NORTHEASTERN COLORADO

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In Colorado, winter wheat was planted on approximately 1.4 million ha (excluding fallow ground) during 1986 (Colo. Dep. Agric. 1987). Because most farms used a biennial wheat-fallow cropping rotation (wheat from Sep to Jul, fallow from Jul through the next 14 months to Sep), a similar amount of land remained fallow. In southeastern and east-central Colorado, most stubble fields were cultivated soon after July harvest, so little residual cover remained until the ground was planted in early fall of the subsequent year. However, in northeastern Colorado most of the 0.6 million ha of fallow ground remained in standing winter wheat stubble from July harvest until the following spring when tillage was initiated to control weeds and accumulate soil moisture. Green wheat became the dominant nesting cover each spring as wheat stubble was removed by tillage (Snyder 1984). Under conventional farming methods (employing tillage and no herbicides, and used on >95% of land in wheat), the chronologies of stubble cultivation and nesting by ring-necked pheasants (*Phasianus colchicus*) have coincided, resulting in loss of most initial nesting attempts in stubble.

No-till (biennial and annual; 20,800 ha) and ecofallow (22,500 ha) cropping systems potentially increase security and productivity of small grain stubble fields for nesting birds (Baxter 1982, Cowan 1982, Nason 1982, Snyder 1984, Sugden and Beyersbergen 1985, Duebbert 1987, Duebbert and Kantrud 1987). Use of no-till (herbicides replace cultivation for weed control and allow residual covers to remain standing) and reduced-till cropping systems (combinations of herbicides and tillage are used) has increased in recent years (Natl. Res. Counc. 1982), often because of promotion by conservation agencies, conservation societies (Schnepf 1983), chemical companies, and subsidies under the U.S. Department of Agriculture's farm programs. Among reduced-till methods, ecofallow has rapidly become the most popular because it yields 2 crops in 3 years. A row crop (usually corn or sorghum) or millet is planted directly into the standing, herbicide-treated stubble of the previous year's wheat and the ground is fallowed (usually by conventional methods) the third year (Wicks and Nordquist 1977, Baxter 1982, Nason 1982).

This paper discusses the potential security of wheat stubble for nesting in no-till and ecofallow cropping systems, in comparison to the