OBSERVATIONS OF WOODCOCK WINTERING IN COASTAL SOUTH CAROLINA

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Abstract: Winter populations of American woodcock (*Philohela minor*) in coastal South Carolina were concentrated in cypress-gum (*Taxodium-Nyssa*) swamps and flood plains and along the margins of ponds in pine (*Pinus*) stands and clearcuts. Flushing rates varied from 0 to 6 flushes per man-hour in the field based on 303.4 man-hours of hunting. The winter population began to increase in mid-December, was highest in mid-January, and was low by late-February. Age and sex ratios were largely skewed towards the immature female segment of the population. Earthworms made up 64% of the aggreate volume of 122 proventriculi. DDE, Mirex, and PCB's were the main pollutant residues found in the abdominal fat of 41 birds although these were at lower levels than previously reported.

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The American woodcock has been a popular game resource in Louisiana, the Lake States, northeastern United States, and eastern provinces of Canada. Pursglove and Doster (1970) found abundant woodcock in several southeastern states and indicated that the species was a virtually ususued resource. Woodcock have received little research or hunting attention in this area even though banding data of Krohn and Clark (1977) indicated that the Atlantic Coastal Region of the Southeast may be an important wintering ground for birds produced in New England.

In the fall of 1977, an investigation of woodcock populations wintering in coastal South Carolina was initiated. The objectives of this study were to determine: (1) the nature of diurnal woodcock habitats in coastal South Carolina; (2) the abundance of birds within these habitats; (3) age and sex characteristics of the population; (4) woodcock food habits; and (5) pollutant residues in woodcock fat tissue.

STUDY AREA

The 1,009 km^2 Francis Marion National Forest located in Berkeley and Charleston Counties was chosen as a study area because it was representative of South Carolina Lower Coastal Plain wildlife habitats, and was accessible for research. Soil and landforms on the Forest range from deep sands on ridges to plastic clays found in swamp bottoms and along creek flood plains. Elevations range from mean high tide on the Atlantic Ocean to 88 feet above sea level on the northeastern corner of the Forest. Approximately 98% of the Francis Marion is forested with the remaining 2% being comprised of water, roads, powerline rights-of-way, and wildlife openings. Forested acreage is 50% loblolly pine (*Pinus taeda*), 20% longleaf pine (*P. palustris*), 27% bottomland hardwoods and 3% pine-hardwood (U.S. Forest Service 1977).

METHODS

Twelve study sites were subjectively chosen on the bases of soil moisture and understory vegetation conditions which seemed to be suitable for woodcock habitat. These conditions prevailed along the flood plains of creeks, hardwood drains, and ponds margins. Size of study sites varied from areas of 10 to 15 ha around ponds to areas whose size was only governed by the amount that could be hunted in an afternoon and would cover several hundred hectares. These study sites were hunted for woodcock during the winters of 1977-78 and 1978-79.

Flushing rate was used as an index to relative abundance of birds on the study sites. This technique has been used by a number of workers in the absence of any quantitative

method of censusing woodcock populations in Fall. Bird dogs were used to help locate and flush birds. The length of search time on each site and the number of flushes were recorded. An attempt was made to avoid including repeats in flushing counts. Flushing rates were calculated on both hunting party-hour as well as man-hour bases.

Checks for breeding activity were made in late-February and early-March 1979 by visiting clearcuts adjacent to known diurnal habitat and listening for singing males during early evening hours.

Woodcock were collected during hunts on study sites. Collected birds were aged according to Martin (1964) and sexed by gonadal examination or according to Artmann and Schroeder (1976). Testes lengths and diameters of largest follicles were measured with vernier calipers. The esophagus and proventriculus were removed for determination of contents. Fat sample specimens were collected for pollutant residue analysis.

Age and sex data were placed in contingency tables and between year comparisons and comparisons with similar data from other studies were analyzed by X^2 - tests (Maxwell 1961). Simple linear and quadratic models constructed by the least squares method were used to examine trends in follicular development with time. Simple linear and nonlinear sigmoid models were also constructed by the least squares method to illustrate trends in testicular development with time.

Ingesta in the esophagus and proventriculus were separated by category as to: annelids, crustaceans, insects, plant materials and unidentified materials, and measured volumetrically by water displacement in a 10 ml graduated cylinder.

In March of 1979, samples of earthworms were collected from 5 of the study sites and frozen for later examination of pesticide residues. Pesticide analyses of earthworm and fat samples were contracted to the Department of Poultry Science, University of Georgia. Analyses for concentrations of the following chemicals were made: Aldrin, BHC, Carbophenalthion, Chlordane, DDD, DDE, DDT, Dieldrin, Endrin, Heptachlor Epoxide, Lindane, Malathion, Methoxychlor, Methly Parathion, Mirex, PCB's, Parathion and Toxaphene. Analyses were made on ether extracts of samples according to the techniques of Bush et al. (1977). Concentrations were expressed on a fresh weight of sample basis.

RESULTS AND DISCUSSION

Habitat

Woodcock were found in forested cover-types located in the flood plains and swamps of the major drainages and in the transition zones of these areas with upland flats, side slopes and ridges. Isolated groups of birds were also found around small ponds located within pine stands and clearcuts. Flood plain and swamp areas were characterized by bald-cypress (*Taxodium distichum*), swamp tupelo (*Nyssa sylvatica* var. *biflora*) water tupelo (*N.* aquatica), red maple (*Acer rubrum*), ashes (*Fraxinus* spp.),and laurel oak (*Quercus laurifolia*) in the overstory and switchcane (*Arundinaria tecta*), sedges (*Carex* spp.), and greenbriers (*Smilax* spp.) in the understory. Overstory layers of transition zones included those species found in flood plain areas in addition to sweetgum (*Liquidambar styraciflua*), loblolly pine, water oak (*Q. nigra*), and willow oak (*Q. phellos*). The understory in transition zones was composed of switchcane, greenbriers, blackberries (*Rubus* spp.), wax myrtle (*Myrica cerifera*), grape (*Vitis* spp.), rattan vine (*Berchemia scandens*), dwarf palmetto (*Sabal minor*), and to a lesser extent hawthornes (*Crataegus* spp.), blueberries (*Vaccinium* spp.), American holly (*Ilex opaca*), sweetgum, and red maple. Margins of ponds in pine stands had primarily cypress-tupelo overstories with sweet pepperbush (*Clethra alnifolia*), and wax myrtle in the understory. Margins of ponds in clearcuts had tupelo overstories with wax myrtle, blackberries, rattan vine and sedges in the understory. A detailed analysis of the vegetation of 200 flushing sites

distributed over 12 study sites is underway currently to describe woodcock habitats quantitatively in the Lower Coastal Plain of South Carolian.

Woodcock Abundance

Overall flushing rate was 1.84 flushes per man-hour (F/MH) of hunting or 4.47 flushes per party-hour (Table 1). Party size ranged from 1-4 hunters and 1-4 dogs; 70% of the hunting time was done by parties consisting of 2-3 hunters and 2 dogs.

TABLE 1. Results from 38 days of woodcock hunting in the Francis Marion National Forest, South Carolina, during the winters of 1977-78 and 1978-79.

Time Period	Days Hunted	Party Hours Hunted	Man Hours Hunted	Number of Flushes	Number of Birds Bagged (lost)	Flushes per Party-Hour	Flushes per Man-Hour
December 3, 1977 through February 21, 1978	13	41.8	97.2	136	29 (1)	3.26	1.40
December 2, 1978 through February 28, 1979	25	82.8	206.2	241	128 (3)	5.08	2.40
Total	38	124.6	303.4	377	157 (4)	4.47	1.84

In comparison to similar data from other studies, our results indicated that Lower Coastal Plain habitats in South Carolina support concentrations of woodcock similar to other areas. For example, in Michigan Blakenship (1957) reported 1.7 F/MH for the years 1954-55, and Ammann (1969, in Pursglove 1975) found flushing rates of 1.2 and 1.4 F/MH for 1967 and 1968, respectively. In Pennsylvania, hunters averaged 0.71 F/MH for the years 1952-56 (Liscinsky 1972). In West Virginia, hunters averaged 1.3 F/MH from 1966-69 (Goudy et al. 1970). A hunter survey in northeast Georgia revealed that hunters averaged 1.56 F/MH during the winters of 1969-74 (Pursglove 1975).

Chronology of Migration

Flushing rates on a party-hour basis indicated that winter woodcock populations in coastal South Carolina began increasing about the middle of December, maintained high numbers throughout January and early-February, and disappeared from their winter diurnal habitats by late-Feburary (Fig. 1). While woodcock numbers declined 2- to 3-fold in swamp and flood plain habitats by late-February, high numbers still could be found near ponds in clearcuts with as many as 10 flushes per hour.

Clearcuts believed to provide habitat for singing grounds were not checked until late-February and early-March 1979 for courtship activity. On February 20 a total of 7 male woodcock were seen in courtship flight or heard singing in 2 clearcuts. A check made on February 28 revealed only 4 birds singing on these same areas. Checks of 4 clearcuts on March 12 produced no singing birds which was interpreted as meaning that most if not all migrant males had departed.

Age and Sex Composition

Contingency table analysis showed no differences in age and sex composition between years ($X^2 = 2.40$, $P > 0.75$, 3 d.f.). Combined age and sex composition for the 2 years was 38% immature females, 28% adult females, 27% immature males, and 7% adult males.

Chi-squre analysis revealed that females represented significantly more than 50% of the population ($X^2 = 17.48$, $P < .005$, 1 d.f.). The observed ratio of 50 males: 100 females

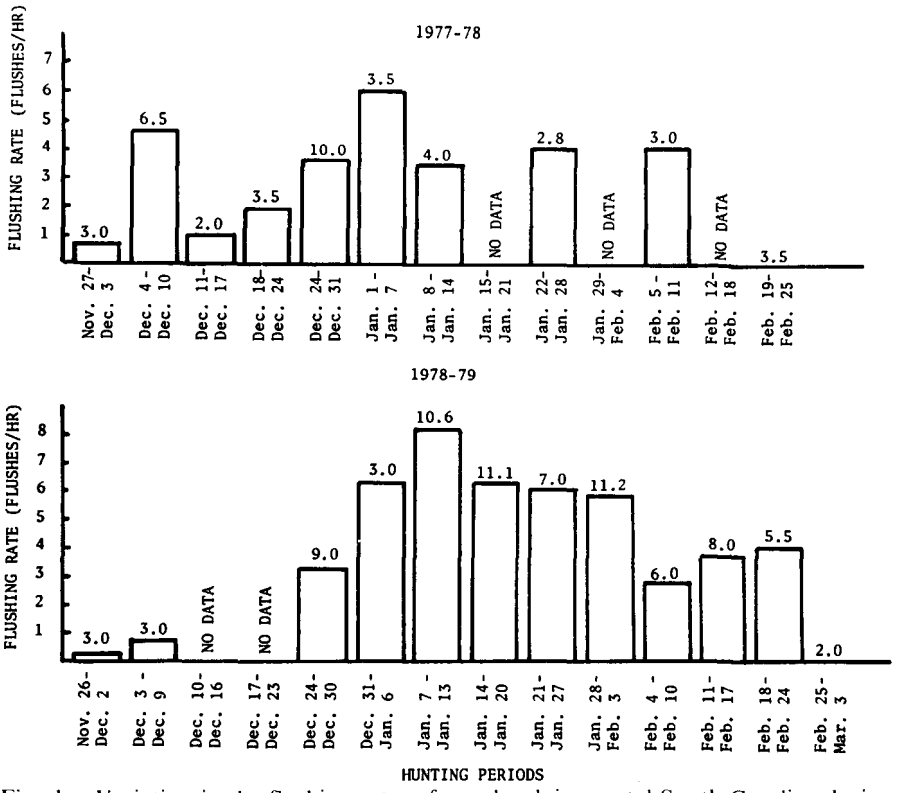

Fig. 1. Variation in the flushing rates of woodcock in coastal South Carolina during the winters of 1978 - 1979. Total number of hours hunted appear above each bar.

indicated that the male segment of the coastal South Carolina population was smaller than had been observed in other areas. Mendall and Aldous (1943) reported a fall sex ratio of 75:100 (males:females) among 669 birds from Maine, New Brunswick, and Nova Scotia. Other studies reported fall and winter ratios of 86 males: 100 females in Wisconsin (Greeley 1953), 86 males: 100 females in Michigan (Blakenship 1957), and 70 males: 100 females in Louisiana (Glasgow 1958).

A comparison of the combined 1977-78 and 1978-79 data from coastal South Carolina with data from the the 1977-78 wing-collection survey for the entire Atlantic Region (Office of Migratory Bird Management, U.S. Fish and Wildlife Service, Laurel, Maryland 20811) revealed significant differences between coastal South Carolina and Atlantic Region data in overall age and sex distributions ($X^2 = 33.54$, $P < 0.005$, 3 d.f.). There was a significantly greater proportion of females ($X^2 = 9.31$, $P < 0.005$, 1 d.f.) and a significantly greater propotion of immatures ($X^2 = 19.94$, $P < 0.005$, 1 d.f.) in coastal South Carolina than in the Atlantic Region as a whole. In comparison to the data of Stamps and Doerr (1978) for the Coastal Plain of North Carolina there were no significant differences attributable to age, but the South Carolina population had a significantly higher proportion of females than coastal North Carolina ($X^2 = 4.83$, $P < 0.05$, 1 d.f.).

The percentages of immatures and females in our data are notably high. Martin et al. (1965) suggested that the percentage of the population composed of immatures would be

higher in coastal areas than inland areas. This is further supported by data collected in Cape May, New Jersey (Krohn et al. 1977) and coastal North Carolina (Stamps and Doerr 1978).. Glasgow (1958) believed that because most males leave the wintering grounds on their spring migration 3 weeks before females, his estimates of woodcock sex ratios in Louisiana were biases. In addition, Willims (1969) found that in Louisiana males arrived later on wintering grounds than females. Since the proportion of our sample taken during migration periods was small, it is doubtful that possible differences in the chronology of migration between sexes could account of the high proportion of females observed in coastal South Carolina.

Changes in Reproductive Condition

Changes in the reproductive condition of female woodcock were determined by measuring the largest ovarian follicle in each of 58 females collected during the period January 8 to February 20, 1979. Follicles ranged in size from 1.0 to 4.5 mm in diameter. Fig. 2 presents the means and standard deviations of follicle size and the numbers of birds included on each observation date. Due to the large variation in follicle size the numbers among birds taken on the same date, neither the simple nor quadratic models were adequate as predictors of trends in reproductive condition change. Furthermore, the large variation observed indicates that reproductive condition in this population is not predictable by any model.

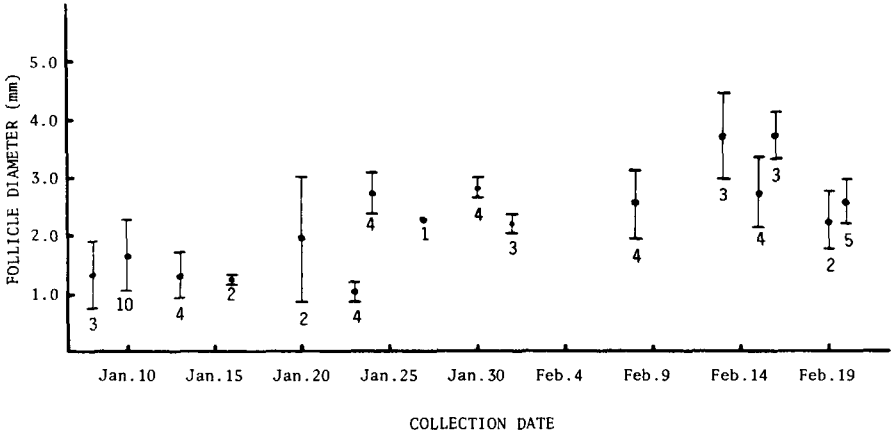

Fig. 2. Means and their standard deviations of the largest ovarian follicle diameter in woodcock collected during 1979. The number of birds examined on each collection date appear below the standard deviation.

Stamps and Doerr (1977) suggested that woodcock follicles greater than 4 mm in diameter were undergoing accelerated maturation. On the basis of a 4.0 mm threshold, they indicated that 67% of the woodcock collected during February 1974 and 1975 in North Carolina were close to nesting. Using the same criterion in Tennessee, Roberts and Dimmick (1979) found that 44% of the females collected in February 1977 and 52% of those collected in February 1978 would have begun nesting in a short period. In contrast, none of the 34 female woodcock collected in Janurary and only 2 of 24 (8.3%) collected in February of this study had ovarian follicles greater than 4.0 mm.

The examination of testes length showed that in 1979 male woodcock in coastal South Carolina had undergone considerable recrudescence by early February. Left testes lengths ranged from 3.7 to 11.7 mm in the 38 males collected with sizes varying substantially amoung birds at any given time. Variation among birds was so large that

neither the simple linear or sigmoid models were adequate to illustrate growth trends. Actually the simple linear model had a lower mean square error term than the sigmoid which is the reverse of what was expected.

Food Habitats

Results from the examination of proventriculus contents of 122 woodcock wintering in coastal South Carolina differed little from studies in Louisiana (Glasgow 1958, Britt 1971). Earthworms (Lumbricidae) comprised 69% of the aggregate food volume with the remainder being primarily larval insects (23%) and crustaceans (3%).

Pollutant Residues

Tests for 19 pollutant residues in 41 woodcock fat samples revealed that DDE, Mirex and PCB's were the only compounds with detectable amounts occurring frequently (Table 2). Detectable amounts of Dieldren and Chloradane were found in one sample

TABLE 2. Polutant residues in coastal South Carolina woodcock 1978-79.

Compounds	Detectability Limits (ppm)	Number of Samples Total	Without Detectible Residues	Witl. Trace Residues	With Measureable Residues	Concentrations (ppm Wet Weight) Mean ± S.D. of Measureable Residues	Median	Range
Aldrin	0.01	41	41	0	0		ND*	-
BHC	0.01	41	41	0	0		ND	-
Carbophenalthion	0.10	41	41	0	0		ND	-
Chlordane	0.10	41	40	0	1	17.07 ± NM**	ND	ND - 17.07
DDD	0.01	41	41	0	0	-	ND	-
DDE	0.01	41	0	1	40	3.03 ± 4.05	1.46	Trace - 17.3
DDT	0.01	41	41	0	0	-	ND	-
Dieldrin	0.02	41	40	0	1	0.43 ± NM	ND	ND - 0.43
Endrin	0.02	41	41		0	-	ND	-
Heptachlor	0.01	41	41	0	0	-	ND	-
Helptachlor Epoxide	0.02	41	41	0	0	-	ND	-
Lindane	0.01	41	41	0	0	-	ND	-
Malathion	0.10	41	41	0	0	-	ND	-
Methoxychlor	0.05	41	41	0	0	-	ND	-
Methyl Parathion	0.10	41	41	0	0	-	ND	-
Mirex	0.10	41	4	1	36	1.53 ± 0.91	1.53	ND - 3.84
PCB	0.20	41	8	7	26	2.33 ± 2.51	2.40	ND - 13.53
Parathion	0.05	41	41	0	0	-	ND	-
Toxaphene	0.10	41	41	0	0	-	ND	-

*ND = Not Detectible **NM = Not Measured

each. A median concentration of 1.46 ppm (fresh-weight basis) was found in 40 samples with measureable amounts of DDE while the remaining sample showed only trace amounts. Mirex concentrations from 36 samples had a median of 1.53 ppm. One sample showed trace amounts while concentrations of Mirex in the remaining 4 samples were not detectable. PCB concentrations measured from 26 samples had a median concentration of 2.40 ppm. Seven samples showed trace amounts while no PCB's were detected in 8 samples. No detectable pollutant residues were found in the composite earthworm samples taken from 5 of the study sites.

Pesticide analysis is limited in its sensitivity. Thus, it cannot be stated with certainty that less than detectable concentrations of organochlorides in these earthworms do not significantly contribute to residue levels in woodcock. However, it seems more likely that the observed residue levels in fat samples resulted from woodcock foraging in agricultural

and other areas more subject to organochloride contamination than the coastal forests of South Carolina.

Previous studies have expressed residue concentrations on a lipid-weight basis based on total body or muscle tissue extraction. Since abdominal fat is 100% lipids, it is reasonable to assume that pollutant residues of lipid soluble compounds taken from abdominal fat samples and their concentrations expressed on a fresh-weight basis are approximately equivalent to concentrations expressed on a lipid-weight basis (Parshall B. Bush, Department of Poultry Science, University of Georgia, personal communication). Based on this assumption, concentrations of DDE, Mirex and PCB's were not as high as previously reported from other areas. In 1971, woodcock seasons were closed in parts of New Brunswick, Canada when total DDT residues in woodcock from heavily sprayed areas averaged 60 ppm lipid-weight basis (Pearce and Baird 1971). McLane et al. (1971) reported that Louisiana woodcock collected during the winter of 1965 contained an average of 17.9 ppm (lipid-weight basis) of DDE. After grouping samples taken during 1970-71 from North Carolina, South Carolina and Georgia into a single tri-state area sample, McLane et al. (1973) reported mean concentrations of 47.47, 4.08 and 8.63 ppm (lipid-weight basis) for DDE, Mirex and PCB's. They also stated that mean levels of Mirex and DDT and its metabolites in Louisiana and the tri-state area samples were significantly higher than the levels in 7 other states for the same time period. Clark and McLane (1974) reported residues of chlorinated hydrocarbons in a total of 5 woodcock collected from Georgetown and Lancaster counties of South Carolina. Concentrations averaged 10.2 ppm total DDT (DDT + DDD + DDE), 6.7 ppm Dieldren, and 4.36 ppm PCB's.

CONCLUSIONS

The results of this study indicated that in the Lower Coastal Plain of South Carolina, diurnal habitat for wintering woodcock consisted of the forested cover-types located in the flood plains and swamps of major drainages and in the transition zones of these areas with upland flats, side-slopes and ridges. Isolated groups of woodcock were also found along margins of small ponds located within pine stands and clearcuts. In these habitats, woodcock abundance began to increase during mid-December and populations were quite high from late-December to mid-February. It appeared that wintering populations of woodcock in coastal South Carolina may constitute a substantial huntable resource.

Coastal South Carolina populations were made up of significantly more females and immatures than the population of the Atlantic Region taken as a whole. Age ratios were not different from those reported for coastal North Carolina, but the proportion of females was significantly higher.

There was great variability in changes in ovarian follicle sizes and testes recrudescence from January 10 through February 20. Only 2 of 24 (8.3%) females examined in February were approaching nesting condition based on size of the largest follicle. Probably few, if any, woodcock nested in coastal South Carolina in February although substantial singing-ground activity was observed during this month.

DDE, Mirex, and PCB's were the only pollutant residues occurring in measureable amounts in most of the 41-bird test population. Our findings showed lower amounts of these chemicals than have been previously published.

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