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Sexual Development During Winter in Male American Woodcock

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Recent studies of American Woodcock (*Philohela minor*) have documented that substantial breeding occurs throughout much of the southeastern United States, an area formerly considered to be significant only as a wintering ground (Causey et al. 1974, Stamps and Doerr 1977, Roberts and Dimmick 1978). Woodcock are among the earliest breeders of North American avifauna, but the chronological pattern of their reproductive cycle has not been adequately described. This study was undertaken to delineate the sexual development in the male segment of the population during winter and to determine whether or not physiological differences exist between adult and subadult males.

Woodcock were collected from 17 December 1978 to 26 February 1979. Collection sites were southeastern Louisiana, east-central Mississippi, and western Tennessee. Birds were classified as adults or subadults according to characteristics of the secondaries (Martin 1964). After measurement and fixation in 10% formalin, cross sections of left testes were prepared for histological examination. Sections (6 μ) were stained with hematoxylin and eosine and examined with a binocular microscope under 100×. Based on the degree of gonadal development, males were classified into three groups: Class I—sexually mature (spermatozoa present in all seminiferous tubules); Class II—spermatogenesis occurring but not yet sexually mature (spermatids present in most tubules; spermatozoa present in some cases but only in a few tubules and not in large numbers when present); and Class III—quiescent (only spermatogonia present; no evidence of spermatogenesis).

Forty-seven males were collected during the study. The size of the 43 testes measured ranged from 3.0 mm to 12.0 mm. Considerable variation existed among individuals on any given date, but there was a trend toward increasing testis length during the study period (Fig. 1). There was no significant difference in the regression equations ($P = 0.95$) of adults and subadults when evaluated separately. The earliest date that spermatogenesis was observed was 19 January, while the earliest individual in Class I was collected on 22 January. All birds taken after 1 February ($n = 22$) were in Class I or Class II; 76% were in Class I. The Mann-Whitney u-test (Conover 1971) showed no difference in testis size between 14 adult and 14 subadult males collected during February ($P > 0.1$). Of the subadults shot in February and examined histologically, 91% were in Class I. No difference in either testis size or degree of development that might be attributable to collection site was apparent in the data.

Of 39 testes that were examined histologically, 97% of those greater than or equal to 6.0 mm were in Class I or Class II, with 76% being in Class I. Only 14% of those less than 6.0 mm ($n = 7$) were in Class II; none was in Class I. All less than 5.0 mm ($n = 5$) were in Class III.

Although there was individual variation, the majority of the male woodcock in my sample had attained full breeding condition by early February. Recrudescence of gonads began at least as early as mid-January, although the small number of samples before that period precluded a more precise determi-

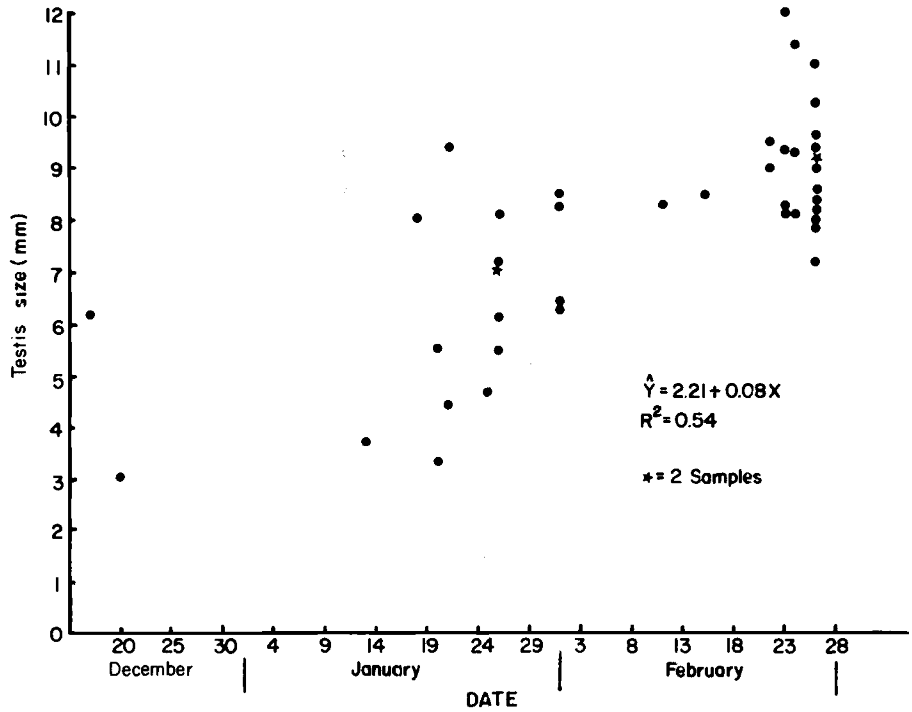

Fig. 1. Testis size of 43 woodcock collected in the Southeast during winter, 1978–79.

nation. I have observed male woodcock performing courtship flights in the Southeast even during December, so gonadal maturation in some males may begin several weeks before the period first observed during this study. Complete sexual maturation several weeks before the normal breeding period probably is necessary for males to establish and defend territories on the breeding grounds. This assumption is supported by evidence that male woodcock initiate spring migration to the breeding grounds several weeks before females (Glasgow 1958, Owen 1977) and that migration commonly begins by early to mid-February (Glasgow 1958, Stamps and Doerr 1976, Roberts 1978).

Subadult males apparently contribute to the spring breeding population, as they are not physiologically different from adults, as evidenced by the rate of testis development and the degree of spermatogenic activity. Their initial role, however, may be as part of the surplus population of nonbreeding males described by Sheldon (1967), Goudy et al. (1970), and others. Subadults may take over abandoned singing grounds after the initial peak breeding period and function by being available to inseminate late-nesting females or females attempting to renest. This theory is supported by limited data that show that adult males are much more common on singing grounds in Michigan before mid-May, while subadults are more common during the remainder of the breeding period (Whitcomb 1974).

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Feather Pigmentation and Abrasion: Test of a Hypothesis

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Explanation in ecology and evolutionary biology frequently is characterized by the discernment of pattern in the natural history of organisms, followed by the inference of cause to factors thought to be sufficiently important to have given rise to the pattern. Unfortunately, the process may end at this point because of difficulties in getting real organisms to adjust their behavior, size, shape, or color in such a manner as to yield control and experimental conditions and, hence, to lead to a test of the hypothesis. Laboratory experiments may lend support or raise doubts about the hypothesis, but the verification of the importance of the hypothesized factors in natural populations frequently rests on the observation of the results of natural experiments.

Recently, Burtt (1979) examined the relationship between feather coloration and wear due to abrasion. Earlier authors had mentioned anecdotal and qualitative observations about color and feather wear, for instance in the primaries of gulls (Averill 1923); Burtt, however, undertook a careful laboratory study of the abrasive effects of particles of silicon on the tail feathers of wood warblers. Based on the differential effects of this abrasion on feathers with and without melanin, along with the observed pattern of occurrence of melanic feathers among species of wood warblers, he concluded that the resistance to abrasion conferred on feathers by melanin was of sufficient importance that it should be considered an ecological function of the coloration. Nevertheless, the critical test of this hypothesis requires the observation of whether unpigmented feathers on a member of a natural population suffer significant wear due to the levels of abrasion normally encountered by a wild bird. Otherwise, one might conclude that Burtt's laboratory results were due to an unrealistically high particle flux. Recently, we happened upon a natural experiment that may help to elucidate this matter.

We collected a partial albino adult male Yellow-rumped Warbler (*Dendroica coronata auduboni*) in the Cascade Mountains of Washington on 10 July 1977 (Bell Museum Nat. Hist. No. 31921). The albinism was limited to the outer five primaries of the bird's left wing. Thus, primary feathers with and without melanin, on the right and left wings, were exposed, since the previous molt, to the same natural

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