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Thomas A. Nelson
Arkansas Tech University

Michael W. Johnson
Arkansas Tech University

FECUNDITY OF MALE WHITE-TAILED DEER ON HOLLA BEND NATIONAL WILDLIFE REFUGE

THOMAS A. NELSON and MICHAEL W. JOHNSON
Fisheries and Wildlife Biology Program
Arkansas Tech University
Russellville, AR 72801

ABSTRACT

Male reproductive tracts were collected from 57 white-tailed deer *(Odocoileus virginianus)* harvested on Holla Bend National Wildlife Refuge during the 1988 and 1989 archery deer seasons. Organ weights and total numbers of spermatozoa present were determined for both testes and epididymides. Among yearling and adult males, the mean weights of testes and epididymides peaked during November and decreased through the end of the collection period in mid-December. Total number of spermatozoa in the tract increased through October, peaked during the last half of November, and decreased through mid-December. No significant difference was found between the mean number of spermatozoa in the tracts of yearling (1.5 years old) and adult ≥ 2.5 years old) males ($p = 0.48$). Testicular spermatozoa numbers ($\times 10^9$) averaged 2.9 ± 0.5 S.E. and 3.7 ± 0.6 S.E. for yearlings and adults, respectively. The mean number ($\times 10^9$) of spermatozoa in the epididymides averaged 8.6 ± 1.1 S.E. and 9.8 ± 1.3 S.E. for yearlings and adults. No spermatozoa were found in the epididymides of 19 fawns sampled. However, low numbers of spermatozoa were present in the testes of 3 (16%) fawns.

INTRODUCTION

The white-tailed deer *(Odocoileus virginianus)* is of special interest to wildlife biologists and hunters in Arkansas due to its economic and ecologic value. It is also one of the few game animals harvested during its breeding season. Because mature males are preferentially sought by most hunters, and these deer are very active during the rut, they are particularly vulnerable to harvest (Roseberry and Klimstra, 1974). Presumably the timing of the deer season relative to the rut could impact the reproductive performance of a deer population by excessive removal of males when hunting pressure is high.

Relatively few efforts have been made to delineate the timing or magnitude of spermatogenesis among deer, or to assess differences in the fecundity of males related to age (Payne *et al.*, 1966; Lambiase *et al.*, 1972; Mirarchi *et al.*, 1977). This study was undertaken to determine when the peak of spermatogenesis among mature males occurs, if yearling males produce as many spermatozoa as older deer, and if male fawns in Arkansas undergo spermatogenesis.

MATERIALS AND METHODS

Complete reproductive tracts were collected from 57 male deer harvested on Holla Bend N.W.R. during the 1988 and 1989 archery deer seasons. The archery season on the refuge extended from 1 October through 15 December both years. Dressed body weights and age (estimated by tooth replacement and wear) were recorded for each deer at the deer check station on Holla Bend (Severinghaus, 1949). Reproductive tracts were immediately frozen and returned to Arkansas Tech University for further processing.

Testes and epididymides were removed from the scrotum, separated, trimmed of extraneous materials, and weighed. Each paired organ was then minced, and homogenized in 200 ml of normal saline solution in a blender (Almquist and Amann, 1961). Each suspension was diluted and stained for 8-12 hours with rose bengal to facilitate the counting of spermatozoa. Spermatozoa were counted using a hemacytometer and light microscope. Spermatozoan numbers were expressed as number per organ pair.

Means were calculated separately for paired testicular weights and spermatozoan numbers, and for paired epididymal weights and spermatozoan numbers. Temporal changes in organ weights and numbers of spermatozoa were graphed by grouping data for deer harvested during each half of each month. Differences between the reproductive performance of yearlings and older males were tested using T-tests. The relationship between the total weight of the reproductive tract and numbers of spermatozoa was assessed using the Pearson product-moment correlation. Both tests were conducted at the 0.05 alpha-level using the SAS statistical package (Barr and Goodnight, 1971).

RESULTS AND DISCUSSION

TIMING OF SPERMATOGENESIS

The period of peak spermatogenesis was estimated based on temporal changes in organ weights and numbers of spermatozoa in testes and epididymides. Mean weights of testes and epididymides generally increased through October, peaked in November, and decreased slightly through early December (Fig. 1). Mirarchi *et al.* (1977) reported that testicular weights peaked in October, and epididymal weights peaked in November in deer sampled in Virginia.

All yearlings and adults harvested on Holla Bend during early October had spermatozoa present in both the testes and epididymides (Fig. 1). This suggests that spermatogenesis was initiated prior to the beginning of archery season in virtually all antlered males. Significant numbers of sperm in the reproductive tract have been reported to occur as early as July in Virginia and August in Pennsylvania (Lambiase *et al.*, 1972; Mirarchi *et al.*, 1977). On Holla Bend, peak numbers of spermatozoa occurred in both the testes and epididymides during November, with numbers declining somewhat during the first half of December (Fig. 2). Similar patterns have been reported from Pennsylvania and Virginia (Lambiase *et al.* 1972, Mirarchi *et al.* 1977).

TESTICULAR GROWTH AND SPERM RESERVES

The mean weight of fawn testes was lower than that of yearlings ($P < 0.01$), however no difference was found between testicular weights of yearlings and older deer ($P < 0.07$). Mean weights (g) for paired testes were 6.9 ± 0.7, 41.7 ± 2.2, and 49.3 ± 3.8 for fawns, yearlings, and adults, respectively.

Similarly, epididymal weights were lower in fawns than in yearlings ($p < 0.01$). Yearlings and adults did not differ ($p < 0.08$). Epididymal weights (g) averaged 4.4 ± 0.3, 14.3 ± 0.9, and 16.6 ± 0.9 for fawns, yearlings, and adults.

Testicular weights recorded during this study are lower than those reported from northern states (Cheatum and Morton, 1946; Lambiase *et al.*, 1972), but are comparable to weights reported for deer from central Texas (Robinson *et al.*, 1965). These differences are probably attributable to differences in body size between northern and southern deer populations.

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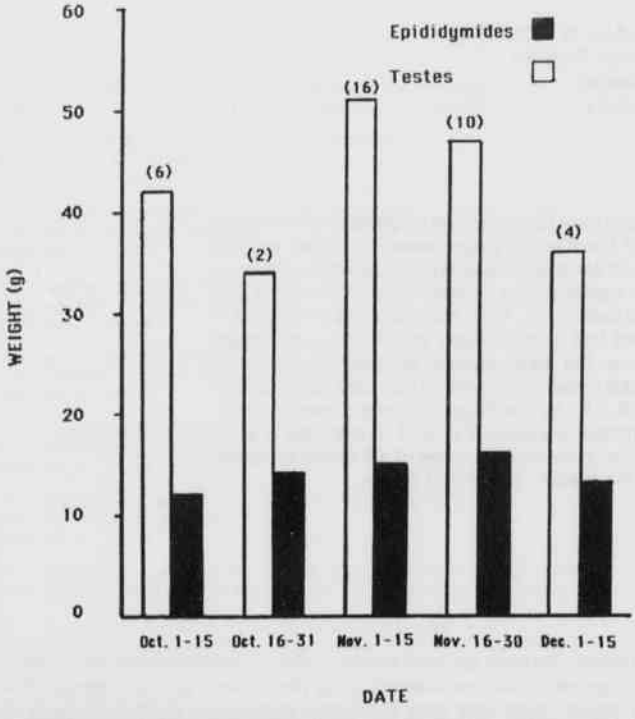

Figure 1. Mean weights of paired testes and epidiymides from yearling and older-age deer harvested during each 2-week period in 1988 and 1989 on Holla Bend N.W.R. Numbers in parentheses indicate sample size.

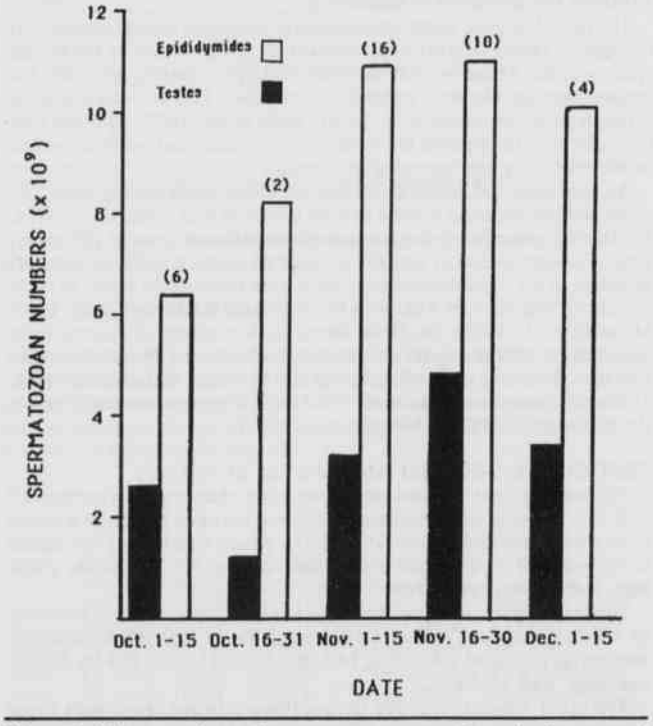

Figure 2. Mean numbers of spermatozoa present in paired testes and epidiymides from yearling and older-age deer harvested in each 2-week period on Holla Bend N.W.R., 1988 and 1989. Numbers in parentheses indicate sample size.

Epididymal weights apparently vary less with season and geographic location. Weights recorded in this study are very similar to those from deer in Pennsylvania and Virginia (Lambiase *et al.*, 1972; Mirarchi *et al.*, 1977).

Yearlings did not differ from adults in the mean number of spermatozoa present in the testes ($p < 0.28$) or epididymides ($p < 0.48$). Yearlings averaged 8.6 ± 1.1 billion spermatozoa in the epididymides, and 2.9 ± 0.5 billion in the testes. Adults averaged 9.8 ± 1.3 billion spermatozoa in the epididymides, and 3.7 ± 0.6 billion in the testes. Lambiase *et al.* (1972) reported sperm reserves in yearlings comparable to those in older males, but noted that this result might have been due to small sample size ($N = 10$). Our results, with a larger sample, support their data.

Sperm reserves and weights of male reproductive organs have been shown to follow a distinct annual cycle in deer (Lambiase *et al.*, 1972). These values are generally lowest from February through June, increase through summer and fall, and peak during October and November. Although the period of collection during this study was limited to 10-weeks (from 1 October through 15 December), this was the peak period of spermatogenesis and breeding. A significant correlation ($r = 0.74$, $P < 0.001$) existed between the combined weight of testes and epididymides and total sperm reserves, suggesting that the increase in organ weights recorded through October and nearly November corresponded to increased spermatogenic activity (Mirarchi *et al.*, 1977).

SEXUAL MATURITY OF MALE FAWNS

Of 19 male fawns sampled, none were found to have spermatozoa present in the epididymides. However, low numbers of spermatozoa ($\bar{X} = 5 \times 10^7$) were found in the testes of 3 (16%) fawns. Sexually mature fawns tended to be heavier (36.0 ± 4.0 kg) than immature males (26.6 ± 1.5 kg); however, the difference was not statistically significant ($P < 0.17$). None of the mature fawns weighed less than 30 kg, although several fawns exceeding 35 kg were sexually immature.

While Cheatum and Morton (1946) found no evidence of fertility among male fawns in New York, Lenker and Scanlon (1973) found that 25% of this class produced spermatozoa in Virginia. Mean weights of mature and immature fawns in the latter study corresponded very closely to those reported above. Follman and Klimstra (1969) reported that 36.9% of male fawns collected during January in southern Illinois were fertile. Fertility was found to be a function of weight, and inferentially of age in the latter study.

Behavioral studies of white-tailed deer have indicated that dominant adult males are responsible for the vast majority of breeding under normal circumstances (Hirth, 1977; Ozoga and Verme, 1985). Subordinate male fawns and yearlings are usually prevented from breeding by these dominant individuals. This is likely the case among most deer populations throughout Arkansas. However, Ozoga and Verme (1985) also reported that there was no decrease in the reproductive performance of captive females when adult males were experimentally removed, and only yearling males were left to breed. They noted that yearlings exhibited age-related differences in rutting behavior, and that less stable dominance hierarchies may have resulted from the absence of older males. Nevertheless, yearlings were capable of successfully impregnating most receptive does when dominant males were removed. Our data indicate that yearling males in Arkansas produce sufficient sperm reserves to maintain herd productivity in the absence of older males.

ACKNOWLEDGMENT

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