Journal of the Arkansas Academy of Science

Volume 45 Article 23

1991

Reproductive Performance of Female White-Tailed Deer on Holla Bend National Wildlife Refuge

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REPRODUCTIVE PERFORMANCE OF FEMALE WHITE-TAILED DEER ON HOLLA BEND NATIONAL WILDLIFE REFUGE

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ABSTRACT

Aspects of the reproductive biology of female white-tailed deer *(Odocoileus virginianus)* on Holla Bend National Wildlife Refuge were investigated by examining the reproductive tracts of 121 deer harvested during the 1985-90 archery seasons. The presence of corpora albicantia in yearlings suggested that 27% of female fawns conceived, producing a mean of 1.0 ova/breeding fawn. Pregnancy rates among yearlings and adults averaged 94% and 97%, respectively. Ovulation rates averaged 1.4 and 2.0 ova/female among yearlings and adults. Some females were ovulating in early-October, but the earliest conceptions occurred during the last week of October. The peak breeding period for yearlings and adults was during mid- and late-November. No fawns ovulated prior to December 1. The implantation rate averaged 91% among yearlings and adults.

INTRODUCTION

The white-tailed deer *(Odocoileus virginianus)* is the most abundant big game animal in Arkansas. Successful deer management programs depend in part on a thorough understanding of the species' population dynamics, including natality, mortality, immigration, and emigration. Of these, natality is most easily estimated, and thus may be the most useful to deer managers and biologists.

To date, only one published study has addressed natality in Arkansas' deer populations (Wilson, 1971). The purpose of this study was to compare reproductive performance of females living on Holla Bend, with that of deer state-wide as reported by Wilson (1971). The objectives of the research were to: (1) delineate the beginning and peak period of reproduction, (2) estimate age-specific ovulation rates, (3) estimate the percentage of female fawns breeding, and (4) estimate implantation rates (percentage of ova fertilized and implanted).

STUDY AREA

Holla Bend is a 1,652 ha Refuge located on a former oxbow of the Arkansas River, 15 km SE of Russellville. The Refuge is managed primarily as a wintering area for waterfowl but supports a large deer population estimated at 300-350 animals.

Plant communities found on the Refuge consist mainly of agricultural fields (corn, soybeans, milo, and millet), old fields, and bottomland hardwood forests dominated by cottonwoods *(Populus deltoides)*, pin oaks *(Quercus palustris)*, and pecans *(Carya illinoiensis)*.

The nutritional plane of resident deer is quite high, due in part to a diet high in corn and soybeans (Nelson *et al.*, 1988). Holla Bend provides a particularly suitable location for studying reproduction of deer because of the: (1) large resident deer population, (2) high quality of habitat, (3) controlled access to the area (entrance and exit is through a single gate), (4) availability of deer carcasses over a long (75-day) period during the breeding season, and (5) requirement that hungers bring harvested deer to a central check-station prior to field dressing the carcass.

MATERIALS AND METHODS

Complete reproductive tracts (ovaries, oviducts, and uteri) were collected from 121 female deer harvested by hunters on the refuge during the 1985-90 archery (Oct. 1 through Dec. 15) deer seasons. The age (estimated by tooth replacement and wear), weight, and condition (based on fat reserves and abomasal parasite counts) were also recorded for each animal (Severinghaus, 1949; Riney, 1955; Eve and Kellogg, 1977). Each tract was labelled and preserved in 10% formalin for subsequent processing. Only those tracts with both ovaries and the uterus intact were preserved.

Temporal analysis of the breeding season was conducted by grouping females harvested during each 2-week period of the archery season. Ovaries were gross-sectioned and analyzed following the method of Cheatum (1949), as modified by Teer *et al.* (1965). Corpora lutea (CL) were considered corpora lutea of pregnancy (CLP) if they were at least 4 mm in diameter. Smaller CLwere considered corpora lutea of estrus (CLE), and were not used to delineate the breeding season in this study (Mansell, 1971).

Uteri were flushed with water and examined for incidence and number of embryos or early-embryonic tissues. The age of each embryo was estimated based on crown-rump length (Armstrong, 1950). Back-dating each embryo from the date of harvest provided estimates of conception dates.

Ovulation rates (number of ova per female) and pregnancy rates (percentage of females pregnant) for each previous year were estimated from counts of corpora albicantia (CA) (Teer *et al.*, 1965). Age-specific ovulation and pregnancy rates were estimated by pooling data from individuals in the fawn (0.5 years old), yearling (1.5 years old), and adult (>1.5 years old) age classes.

RESULTS AND DISCUSSION

TIMING OF OVULATION

The first ovulation of the breeding season frequently does not lead to conception in white-tailed deer (Harder and Moorhead, 1980). Harder (1980) noted that this initial ovulation was not accompanied by estrus, perhaps due to an incomplete hormonal regime. Usually the resulting CLE regresses quickly, and a second ovulation occurs within 2 weeks, usually resulting in fertilization and the development of a larger CLP.

CLE's were evident in some yearling and adult females on Holla Bend in early-October. However, CLP were rarely observed in females harvested prior to the last week of October; two yearlings killed in mid-October did have CLP present. Both of these individuals were particularly fat, and had not produced fawns during the summer. Perhaps relieved of the energetic costs of pregnancy and lactation, they reached a breeding condition earlier than others.

During the first half of November, 75% of yearlings and 55% of adults had CLP. By the end of November, 95% of both classes had CLP present, suggesting that the peak period of breeding occurred during mid- and late-November. This was also the period when peak numbers of spermatozoa were found in the reproductive tracts of adult male deer on Holla Bend (Nelson and Johnson, 1990). Of 20 female fawns examined, none were found to have CLP before December 1. However, among fawns harvested during December 1-15, 16% had developed these structures. Prior studies have shown that fawns frequently breed later than older deer (Roseberry and Klimstra, 1970; Wilson, 1971). On Holla Bend, fawns apparently breed in December, 2-4 weeks after older deer.

AGE-SPECIFIC OVULATION RATES

Mean ovulation rates for fawns, yearlings, and adults were estimated by counting CA in yearlings, 2.5-year olds, and older deer, respectively. Cheatum (1949) estimated that CA persist for 8-12 months following pregnancy, and thus were a reliable indicator of ovulation rates the previous year. Subsequent studies suggested that approximately 15% of CA persist 2-3 years (Golley, 1957; Mansell, 1971). Therefore, CA counts may over-estimate true ovulation rates. In our sample, yearlings averaged 1.4 CA/doe and adults averaged 2.0 CA/doe. Assuming a 15% carryover of CA from previous years, these data suggest that "true" ovulation rates approximate 1.2 and 1.7 ova/doe for yearlings and adults, respectively.

Pregnancy rates could not be estimated directly from CLP in harvested females, as some females would not have conceived when sampling ended on December 15. However, the incidence of CA provides a good estimate of pregnancy rates from each previous year. Based on the percentage of females with visible CA, pregnancy rates were estimated to be 27%, 94%, and 97% for fawns, yearlings, and adults, respectively.

Ovulation rates of white-tailed deer populations in the eastern United States have been found to vary widely. Age and nutrition are thought to be the major influences on reproductive performance (Harder, 1980). Ovulation rates typically increase in each age-class through the first 3 years of life, after which age has little influence.

A large body of research suggests that nutrition also affects reproductive performance, particularly ovulation rates. Poor nutrition, whether due to drought, severe winters, poor habitat, overcrowding, or low soil fertility, generally leads to delayed maturity of female fawns, fewer fawns breeding, and lower ovulation rates among older females (Hesselton and Sauer, 1973; Harder, 1980).

Harder (1980) reported that ovulation rates for adults varied from 1.5 to 2.1 in 10 north central states. The percentage of pregnant fawns varied from 0 to 74%, presumably due to the quality and quantity of available food.

Wilson (1971) estimated a mean ovulation rate of 1.77 ova/doe using CA counts from a sample of 108 yearling and adult females collected across Arkansas. Note that this estimate was not reduced to account for carryover CA from prior breeding seasons.

He found no significant differences in ovulation rates among deer collected in north, central, and south Arkansas. However, deer from physiographic areas that differ significantly in soil fertility and habitat characteristics (e.g. Ouachita mountains and central Delta regions) were pooled for analysis. It seems likely that this pooling may have masked differences among deer in different physiographic regions. Wilson (1971) estimated pregnancy rates of 93% for yearlings and adults, and 41% for fawns.

The reproductive performance of deer on Holla Bend was generally similar to Wilson's (1971) state-wide estimates. Agricultural crops are available on Holla Bend throughout much of the year, and deer are generally in good condition. The advantage provided by these crops, however, may be offset by the high density of the population (approximately 20 deer/km^2). Consequently, females on the Refuge attained but did not greatly exceed, reproductive levels reported by Wilson (1971) in other regions of Arkansas. It should be noted, that the Arkansas deer population has increased significantly since 1971, and deer in many areas may not attain reproductive levels comparable to those reported by Wilson at that time. Another statewide study seems warranted.

Sixteen females carried visible embryos at the time of harvest. Comparing the number of embryos to the number of CLP provided an estimate of the loss of ova between ovulation and subsequent implantation. These data suggest an implantation rate of 91%. Information presented by Harder (1980) indicate that implantation rates typically exceed 87% in most deer populations.

Attempts are currently underway to refine deer management in Arkansas. These efforts include the development of population simulation models to help predict population size and explore the impacts of various harvest scenarios. A necessary prerequisite to the development of realistic models is good estimates of important population measurements, including natality. This study and the previous study by Wilson (1971) provide a basis for estimates of natality in Arkansas deer.

ACKNOWLEDGMENT

The author is grateful for the assistance of Holla Bend refuge manager Martin Perry and his staff. Support for the study was provided by the U.S. Fish and Wildlife Service and Arkansas Tech University.

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