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**EFFECTS OF DELAYED BREEDING ON SUBSEQUENT
REPRODUCTIVE PERFORMANCES OF FEMALE
WHITE-TAILED DEER AND THEIR OFFSPRING**

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Effects of Delayed Breeding on Subsequent Reproductive
Performances of Female White-tailed Deer and Their Offspring

Final Project Report

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Effects of Delayed Breeding on Reproductive
Performance of Female White-tailed Deer and Their Offspring

Harry A. Jacobson

Introduction

Previous studies on reproduction of white-tailed deer in Mississippi have led to the conclusion that overharvest of male deer prior to the peak of rut could have adverse consequences on the reproductive performance of this species (Jacobson et al. 1979, Gruver et al. 1983). This conclusion was based on the observation of a shift in breeding dates recorded for deer in north central Mississippi following a recent history of heavy exploitation of bucks and on empirical evidence derived from computer simulation of reproductive events.

The present study was designed to determine the effects of delayed breeding of captive does on their subsequent reproductive performance and that of their offspring. Over 70% of the harvest of male deer on public lands and on many private lands in Mississippi has consisted of yearling (1½ year old) deer (Jacobson et al. 1981, Mississippi D.W.C. 1982, 1983). In stable populations harvest of yearling males reflects annual mortality rates on antlered deer, therefore, it is reasonable to assume there are few breeding males remaining in many areas of Mississippi at the peak of the rut. The peak rut in most of Mississippi is during the second week of January and this is after most hunting mortality has occurred (Jacobson et al. 1979). Thus, sex ratios may be greatly distorted and during the rut and it is highly plausible that many does do not breed during their first estrous cycle. The objectives of this study were:

1. To determine if does that breed during their second or third estrous cycles as yearlings continue to breed late in subsequent years.

2. To determine the effect of delayed breeding (2nd or 3rd estrous cycle) by yearling does on their specific fertility rates at 2, 3, and 4 years of age.
3. To determine the effects of does breeding schedules on the attainment of puberty of their offspring.
4. To determine the effects of does breeding schedules on subsequent reproductive performance of female offspring as indicated by parturition dates and number of young produced.

Methods

Reproductive histories of 8 does assigned to restricted breeding treatments and 10 control does were monitored during the period February 1977 through October 1983. All deer were maintained on ad libitum diets of 16-21% protein pelleted dairy cattle feed for the duration of the study. Vitamin premix and mineral salt blocks were also provided. Deer were assigned to treatments as follows:

1. One yearling doe obtained in Sept. 1977 was placed with a yearling buck on 1 February 1978.
2. Seven yearling does reared from fawns were randomly assigned to either restricted breeding treatment or as controls in September 1978. Four does assigned to restricted treatment were not placed with a breeding male until February 1, 1979. All control deer were maintained in a pen containing a breeding male from October 1, 1978 until the end of the study.
3. Six additional yearling does were randomly assigned to breeding treatments in 1979. Treatments were as in 2 above, with 3 animals assigned to restricted breeding treatment and 3 as controls.

4. Three additional yearling does were assigned to the control treatment in 1980 to replace mortality losses in this group.
5. All does were maintained in 0.2 - 1.2 ha pens located at the MSU deer research facility. A maximum of 7 does were placed with one breeding buck and following the initial placement of does with a buck, they were maintained continuously with a mature buck until the termination of the study.

In addition to the reproductive histories of the does assigned to treatments above, reproductive histories of all female offspring born in the captive deer research facilities since 1977 have been recorded. All female fawns born in 1978-1981 were maintained in pens with mature male deer for the duration of the study. All fawns born in 1982 were not maintained with adult males, but were confined with fawn males that had hardened antlers in February 1983.

Gestation length data were recorded for a number of deer who were observed in copula with males or were artificially inseminated. Onset of puberty for males is inferred from the date of first hardened antlers. It is well documented that puberty and onset of spermatogenesis in male cervids coincides with acquisition of hardened antlers since testosterone is the hormone responsible for antler mineralization and velvet shedding (Scanlon 1978, Bubenik 1982). Observations also were recorded for reproductive histories of two does transported from Virginia to Mississippi in February 1980. These deer were acquired from Virginia Polytechnic Institute and State University. They were 7½ at the time of acquisition and their complete reproductive history was known.

Results

A chronological listing by birth date of reproductive histories of does used in this study is given in Appendix Table 1. Restricted breeders had median parturition dates 26 days later than the control does during their first fawning season. However, during subsequent years reproductive cycles were essentially the same as the control does (Table 1). The major effect associated with the restricted breeding treatment was the reduction in total number of fawns produced. Total fawn production for restricted deer averaged 2.38 fawns per doe over the first two years following treatment, compared to an average of 3.89 fawns per doe for controls. This effect was primarily due to some restricted does failing to conceive. Two of eight restricted does failed to conceive the year of treatment assignment (deer were $1\frac{1}{2}$ years old) and one of these does along with two other restricted does failed to conceive at $2\frac{1}{2}$ years of age.

Female offspring from restricted and control does had no apparent differences in timing of reproductive events as yearling deer. Two 2 year old females conceived the year of restricted treatment assignment by their mothers, gave birth on 3 and 6 August. This compares to four 2 year old females, conceived by control yearling does, that gave birth to fawns on 27 July, 4, 7 and 18 August.

There was an apparent association between birthdate and attainment of puberty by female fawns. Of 62 female fawns observed in this study, 3 of these gave birth as yearlings. The birthdate of one of these females which conceived as a fawn was unknown except that it was either in June or July. Of the fawns with known birthdates that were not assigned to restrictive breeding treatments (i.e. had the opportunity to breed as fawns), 1 of 4 June fawns, 4 of 18 July fawns, 2 of 24 August fawns, 0 of 2 September fawns and 0 of 1 October fawns conceived as fawns. Thus, a minimum of 26% of June and July

Table 1. Reproductive histories of captive does prevented from breeding until February 1 as yearlings ($1\frac{1}{2}$ year old) deer compared to unrestricted breeding does.

Age Class ¹	Sample Size	% Conceiving	Mean No. ² Offspring	Median Parturition Date	Range in Parturition Dates
<u>Restricted Does</u>					
$1\frac{1}{2} - 2\frac{1}{2}$	8	75.0	1.25	Aug 29	Aug 22 - Oct 1
$2\frac{1}{2} - 3\frac{1}{2}$	8	62.5	1.13	Jul 28	Jul 11 - Sep 19
$3\frac{1}{2} - 4\frac{1}{2}$	7	85.7	1.86	Aug 3	Jul 22 - Aug 15
$4\frac{1}{2} - 5\frac{1}{2}$	5	100.0	1.40	Aug 3	Jul 4 - Oct 26
$6\frac{1}{2} - 7\frac{1}{2}$	4	100.0	1.75	Jul 29	Jul 2 - Sep 21
$7\frac{1}{2} - 8\frac{1}{2}$	1	100.0	2.00	Jul 7	---
<u>Control Does</u>					
$1\frac{1}{2} - 2\frac{1}{2}$	10	100	1.89	Aug 3	Jul 13 - Sep 2
$2\frac{1}{2} - 3\frac{1}{2}$	8	100	2.00	Aug 8	Jun 24 - Aug 26
$3\frac{1}{2} - 4\frac{1}{2}$	6	100	2.00	Aug 13	Jul 11 - Aug 21
$4\frac{1}{2} - 5\frac{1}{2}$	2	100	2.00	Jul 28	Jul 14 - Aug 12
$6\frac{1}{2} - 7\frac{1}{2}$	1	100	2.00	Jul 10	---

¹Does were restricted only as yearlings, performance data given for remaining age classes in both restricted and control treatments are the same animals shown in the yearling class only in latter years.

²Averages include does which did not conceive.

born female fawns reached puberty as fawns, whereas only 7% of female fawns born after 1 August were known to have reached puberty as fawns.

Puberty of male fawns was monitored by recording whether or not they developed or hardened antlers as fawns and shed velvet. Of 47 male fawns with known birth dates, 5 of 5 June fawns, 7 of 18 July fawns, 10 of 19 August fawns, 0 of 4 September fawns and 0 of 1 October fawns developed hardened antlers as fawns. Fawns did not develop hardened antlers before February and most male fawns that developed hard antlers did so between mid-February and late March.

Gestation data were recorded on 7 different occasions. Five of the 7 occasions were observed copulation dates and associated parturition dates. Gestation also was recorded for two does which were artificially inseminated. Adult does had gestation lengths of 194, 196, 201, 202, and 214 days and yearling does had gestation lengths of 197 and 203 days.

Sex of fetuses by age class of their does was also examined. Fawn does were found to conceive a preponderance of males; whereas, yearling and 3, 4, and 8 year old does conceived a preponderance of female fawns. Does 5, 6, 7 and 9 years old had more male fawns than females (Table 2).

The two Virginia does maintained the same approximate parturition dates in Mississippi as were recorded in Virginia, with one exception. One Virginia doe gave birth 4 September 1983. This doe had given birth to all previous fawns in June.

Table 2. Age specific natality rates and sex ratios of offspring for captive white-tailed deer in Mississippi.

Age at Parturition	No. of Pregnant Does Observed	Mean No. of Fawns $\pm$ SE	Sex Ratio of Fawns $\delta:\phi$
1	8	1.00 $\pm$ 0	250:100
2	36	1.44 $\pm$ 0.08	65:100
3	19	1.89 $\pm$ 0.05	94:100
4	16	1.88 $\pm$ 0.15	81:100
5	8	1.50 $\pm$ 0.20	117:100
6	7	1.71 $\pm$ 0.20	200:100
7	3	2.00 $\pm$ 0.00	200:100
8	2	2.00 $\pm$ 0.00	33:100
9	2	1.50 $\pm$ 0.70	200:100

Discussion

The results of this study demonstrate that delayed breeding by female white-tailed deer has an effect on the number of offspring produced. This effect appears to be due primarily to lack of conception. There is evidence that delayed breeding during one reproductive period may have a carry over effect with reduced conception rates in subsequent breeding seasons. However, aside from the effect on conception rate, delayed breeding did not appear to cause subsequent shifts in the breeding dates of treatment does. Restricted does obtained the same approximate parturition dates as control does in subsequent fawning seasons.

Delayed breeding may have some effect on attainment of puberty by female offspring. Evidence for this is seen by a 26% conception rate of June and

July born female fawns, but only a 7% conception rate of fawns born after August 1. Thus, few if any fawns conceived from does during second or third estrous cycles would be expected to reach puberty. The association between puberty and birth date may be primarily a nutritional effect since it has been documented that a minimum size is required for puberty to occur (Sadlier 1969). Onset of puberty by male fawns did not appear to be influenced greatly by birth date. Of 47 male fawns observed, 46% reached puberty as indicated by development of hard antlers. However, earlier born fawns did have a higher percentage with hardened antlers than late born and 5 of 5 June born males reached puberty as fawns.

Puberty of both males and females is reached late in the breeding season. Parturition dates of one year old deer were in September and October, and male fawns did not develop hardened antlers until February and March. The number of male fawns reaching puberty was much higher than the 3% predicted for wild deer by Jacobson and Griffin (1982). This may be explained in part by better nutrition of captive deer allowing them to reach critical body sizes required by puberty. Also large numbers of male fawns are generally only closely observed during the hunting season and none of the captive fawns developed hardened antlers during the normal hunting season dates.

Gestation periods recorded in this study averaged 201 days. This coincides closely with the 204 day average given by Asdell (1954).

Of 159 fawns born in captivity, 75 were males and 94 were females. Age specific fecundity rates of females show sex ratios heavily in favor of female births from 2, 3 and 4 year old does. However, does older than 5 years and yearling does had a preponderance of male fawns.

Since captive deer were maintained on highly nutritional diets, these results would support Verme's (1983) hypothesis that well-nourished deer have

a preponderance of female offspring, whereas, undernourished herds produce a preponderance of male offspring.

Results obtained from parturition dates of two Virginia does gave inconclusive evidence as to the effect of latitude on breeding dates. The first two years after they were moved from Virginia to Mississippi parturition dates were within the range of previous parturition dates by the same does. However, one doe gave birth over two months later than her previous parturition dates in 1983. Whether this indicates a change in breeding date associated with a change in latitude or indicates a failure to conceive remains unknown.

Conclusions

Preventing does from breeding on their first estrous cycle caused a reduction in fertility that carried over into subsequent breeding cycles. Delayed breeding may also have major effects on the timing of reproductive events of offspring. A higher percentage of June and July born fawns reached puberty at 6 months of age than did fawns born in August or later.

Delayed breeding did not have long term effects on breeding schedules. Following initial restriction, restricted does reverted to the same approximate breeding schedules as control does during subsequent breeding cycles. However, it should be noted these results were under conditions of optimum nutrition. Wild animals subject to fluctuating nutritional conditions or less than optimum nutritional conditions might be expected to be more severely affected by breeding restriction than the does used in this study.

Assuming buck doe ratios can be lowered to the point that breeding efficiency is affected, the findings of this study indicate overexploitation of antlered males prior to the peak rut will contribute to lowered fertility and population recruitment.

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Appendix Table 1. A listing of captive does by date of birth and parturition dates and sex of offspring for each doe.

Doe Number	Birth Date	Parturition Dates and Sex of Offspring
1 ¹	July 7, 1973	6/2/75 (♂,♀), 6/12/76 (♂,♀), 6/8/77 (♀), 6/20/78 (♀), 6/15/80 (♂), 6/18/81 (♂,♂), 6/17/82 (♀,♀), 9/4/83 (♂,♂)
2 ¹	July 3, 1973	7/3/76 (♀), 6/3/77 (♂,♀), 5/28/78 (♂), 6/20/80 (♂,♂), 6/20/81 (♂,♀), 7/2/82 (♂,♀), 6/15/83 (♀)
3 ²	Summer, 1976	9/3/78 (♂,♀), no conception 1979, no conception 1980, 7/4/81 (♂,♀), 7/2/82 (♂,♀), 7/7/83 (♂,♀)
4 ²	July, 1977	8/28/79 (♀), 7/28/80 (♂,♀), 7/22/81 (♂,♀), 8/3/82 (♀,♀), 7/15/83 (♂,♀)
5 ²	July, 1977	10/1/79 (♀,♀), 8/17/80 (1 sex unknown), 3/19/81 (♂,♀), 8/9/82 (♂), 8/13/83 (♂,♂)
6 ³	July, 1977	7/18/79 (♀,♀), 7/6/80 (♂,♂), 7/11/81 (♂,♀), 7/14/82 (♂,♂), 7/10/83 (♂,♀)
7 ²	July 10, 1977	8/22/79 (♂,♀), 7/11/80 (♂,♂)
8 ²	July 21, 1977	8/22/79 (♂), no conception 1980, 8/13/81 (♀,♀), 10/26/82 (♀), 9/23/83 (♀)
9 ³	July 21, 1977	7/24/79 (♂,♀), 7/25/80 ⁴ (2 sex unknown)
10 ³	Aug. 5, 1977	8/3/79 (♂,♀)
11 ²	Summer 1978	no conception 1980, no conception 1981, 7/28/82 (♂,♀), 7/26/83 (♀)
12 ³	Summer 1978	8/29/80 (♂,♀), 8/3/81 (♀,♀), 8/9/82 (♂,♀ and 1 sex unknown, fawn was eviscerated by predator)
13 ³	Summer 1978	9/1/79 (♂), 7/13/80 (♀), 6/24/81 (♀,♀)
14 ²	July 18, 1978	8/29/80 (♂,♀), 7/22/81 (♀,♂), 7/25/82 (♂,♀)
15 ³	Aug. 21, 1978	8/31/80 (♀,♀), 8/18/81 (♂,♀)
16 ²	Aug. 31, 1978	No conception 1980, 9/19/81 (♂,♂); 8/15/82 (♂,♂,♀)
17 ²	July 15, 1979	10/16/80 (1 sex unknown ⁴)
18 ⁵	July 18, 1979	8/18/81 (♀), 8/13/82 (♂,♀), 8/10/83 (♀,♀)

Appendix Table 1 continued.

Doe Number	Birth Date	Parturition Dates and Sex of Offspring
19 ³	July 26, 1979	9/2/81 (♂,♂), 8/14/82 (♂,♀), 8/17/83 (♂,♀)
20 ⁵	July 24, 1979	8/7/81 (♀), 8/14/82 (♂,♀), 8/20/83 (♀,♀)
21 ³	Aug. 3, 1979	8/14/81 (♀), 8/26/82 (♂,♀), 8/21/83 (♀,♂)
22 ⁶	Aug. 28, 1979	8/6/81 (♀), 8/14/82 (♂,♀), 8/16/83 (♂)
23 ³	Sept. 1, 1979	8/3/81 (♂,♂), 8/14/82 (♂,♀), 8/9/83 (♂,♂)
24 ⁶	Oct. 1, 1979	8/3/81 (♂), 7/14/82 (♀,♀)
25 ⁶	July 28, 1980	9/9/82 (♀)
26 ⁶	Aug. 29, 1980	8/29/82 (♀)
27 ⁵	Aug. 29, 1980	(failed to conceive 1982)
28 ⁵	Aug. 31, 1980	8/16/82 (♂)
29 ⁵	Aug. 31, 1980	8/21/82 (♀)
30	Oct. 8, 1980	10/9/82 (♀), No conception 1983
31 ⁷	June 18, 1981	7/8/83 (♂,♀)
32 ⁷	June 20, 1981	7/16/83 (♀)
33 ⁶	July 22, 1981	8/9/83 (♂,♀)
34 ⁶	July 22, 1981	8/5/83 (♂,♂)
35 ⁶	July 22, 1981	7/31/83 (♀)
36 ⁶	July 22, 1981	9/25/82 (♂), 8/9/83 (♂)
37 ⁸	Aug. 4, 1981	8/4/83 (♂,♀)
38	Aug. 6, 1981	9/3/83 (♀)
39	Aug. 7, 1981	7/22/83 (♀)
40	Aug. 7, 1981	9/6/83 (♀)
41	Aug. 18, 1981	7/27/83 (♀)
42	June 17, 1982	10/8/83 (♂)
43	June 17, 1982	
44	July 1, 1982	
45	July 2, 1982	
46	July 4, 1982	
47	July 14, 1982	9/12/83 (♀).
48	July 14, 1982	9/7/83 (♂)
49	July 20, 1982	

Appendix Table 1 continued.

Doe Number	Birth Date	Parturition Dates and Sex of Offspring
50	July 25, 1982	
51	Aug. 3, 1982	
52	Aug. 3, 1982	
53 ⁹	Aug. 9, 1982	
54	Aug. 13, 1982	10/24/83 (♀)
55 ¹⁰	Aug. 14, 1982	10/13/83 (♂)
56	Aug. 14, 1982	
57 ¹⁰	Aug. 14, 1982	
58 ¹¹	Aug. 15, 1982	
59 ⁸	Aug. 17, 1982	
60	Aug. 21, 1982	
61 ¹⁰	Aug. 26, 1982	
62	Sept. 9, 1982	
63	Oct. 9, 1982	

¹Obtained from VPI & SU in February 1980

²Assigned restricted breeding treatment, i.e. not confined with a breeding buck as a yearling until February 1

³Assigned as a control during restricted breeding study

⁴Parturition date estimated from conceptus, doe deceased prior to parturition

⁵Mother was a control doe assigned in 1978

⁶Mother was a restricted breeding doe assigned in 1978

⁷Mother Virginia doe

⁸Mother was a control doe assigned in 1979

⁹Mother was a restricted doe assigned in 1977

¹⁰Mother was a control doe assigned 1980

¹¹Mother was a restricted doe assigned 1979