

only during the spring growth flush. Clearly, deer cannot satisfy their minimum requirements for phosphorus from the plants studied. Other sources of phosphorus must be present.

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### REPRODUCTIVE STUDIES OF SOME ALABAMA DEER HERDS\*

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#### ABSTRACT

White-tail deer (*Odocoileus virginianus*) were collected on twelve different areas of Alabama to obtain reproductive data. The earliest average conception date was December 4 for Black Warrior Management Area in north Alabama where there was some breeding as early as November 10. Latest average conception date was February 11 for Fred T. Stimpson Sanctuary in south Alabama where some breeding occurred as late as March 21. Conception dates are thought to be influenced by the genetic stock. Fetal sex ratios were nearly 50/50 on all areas. Production per adult doe varied from 2.0 fawns on Barbour Management Area to 1.1 in Baldwin County.

#### INTRODUCTION

Prior to 1960 there were little data on reproduction within white-tail deer herds in Alabama. A previous paper (Lueth, Francis X., 1956, The Birth Dates of Alabama Deer, Proc. SE Assoc. of Game and Fish Comm. Meeting, Daytona Beach, Florida, Oct. 2-5, 1955) reported birth dates of some Alabama deer as determined by tooth development.

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Limited collections were made in a study of the Choccolocco deer herd in northeast Alabama (Adams, William H., Jr. 1960. Population Ecology of White-tailed Deer in Northeastern Alabama. Ecology 41:785-790). These papers, and the examination of a very few reproductive tracts taken from illegally killed animals and road kills, suggested wide variance in the breeding time of the various deer herds of the State.

In 1960 a study of a deer herd in west-central Alabama was started on Gulf States Paper Corporation's Westervelt Preserve. In 1961 the program gained momentum, and collections were made on other areas. Assistance in collecting was provided by game biologists, refuge managers, conservation officers, land owners or managers, personnel of the Alabama Wildlife Research Unit, and Auburn University students. Animals taken in Alabama by members of the Southeastern Cooperative Wildlife Disease Study were also used for this investigation. The author wishes to thank all of the above for their assistance, and acknowledge the cooperation from the owners of such private lands as Westervelt, Sumter Farms, Choctaw Bluff, Carney Lands and Fort Pierce.

From 1960 through early 1967, a total of 512 animals (132 males, 380 females) was sacrificed at twelve different locations. In addition, over 100 reproductive tracts were examined which were taken during the State's first hunters' choice season from illegal kills and road kills. It should be stated, however, that only ten percent of these reproductive tracts were gravid.

The animals were usually weighed, aged, and the reproductive tracts preserved in ten percent formalin and examined at a later date. Age of the animal was determined by tooth examination. Adjustments were made to give the age as it would be on the animal's next birthday.

When the reproductive tracts were examined, the ovaries were sliced and the number of corpora lutea noted. There were 176 reproductive tracts that contained both the two ovaries and the uterus with visible embryos or fetuses. In this series of tracts, there were 324 corpora lutea and 291 fetuses. Eighty-one percent of the tracts had equal numbers of corpora lutea and developing young. There were five occasions when there were more corpora lutea than young, but in two of these cases, the extra corpora lutea showed evidence of degenerating. When the number of embryos could not be identified, the number of corpora lutea was used as the criteria for the number of fawns to be produced. This would slightly overestimate production on some areas where there was a preponderance of early collections. The number of such early collections was too few and scattered to affect the overall production figures. After the ovaries had been examined, the uterine sac was opened and the embryos or fetuses removed. The physical characteristics and the crown-rump length of the embryos and the forehead-rump length of the fetuses were recorded. The Armstrong method of ageing the developing young was applied (Armstrong, R. A., 1950, Fetal Development of the Northern White-tailed Deer (*Odocoileus virginianus borealis* Miller). Am. Midland Naturalist 43:650-666). There were two exceptions to this method. The first exception occurred when the embryo was too small to measure. Where ovulation had occurred but no membranes had developed, the conception date was estimated at ten days prior to collection; where there were membranes but an embryo too small to measure, conception was estimated at twenty days prior to collection. The second exception occurred when the doe had fawned prior to collection. If stomach contents (after birth) and colostrum indicated very recent birth, the estimated conception was given as 200 days plus 24 or 48 hours. No conception date could be determined for heavily lactating does.

For purposes of this study, it was assumed that every pregnant female would carry her fawn or fawns to full term. There was no evidence that any fetus was being resorbed in the animals examined.

## RESULTS

*Time of conception and production:* The average conception date is the average date as determined by back dating of fetal materials. All gravid tracts were used regardless of the age doe from which it came, the season the collection was made, or the year it was made.

Production is the term used hereafter to denote the number of fawns per adult doe. Average production of a given herd includes the various age classes, except that nonpregnant year-old does were excluded. Barren does of two or more years of age were included only if the collection was made at least twenty days after the average conception date of the year of study.

There are twelve areas in Alabama where the reproductive tracts of seven or more pregnant females are available for study. Figure 1 is a map of the localities and the average conception date for the twelve study areas. Table 1 shows the number of females examined that conceived in given half-month periods. Table 2 gives the number of fawns per doe arranged by age groups. The sex of the fetuses is also given in this table.

TABLE 1—NUMBERS OF PREGNANT DOES EXAMINED THAT HAD CONCEIVED IN THE PERIODS GIVEN.

Area	November		December		January		February		March	
	1-15	16-30	1-15	16-31	1-15	16-31	1-15	16-28	1-15	16-31
Lauderdale .....			6		1	2				
Thomas .....	1				1	1	4	1		
Black Warrior ... 8	6	1					2	1		
Choccolocco .....	14	15			3	1				
Westervelt .....			9	18	12	4	2			
Sumter Farms ...			6	42	37	11	3	1		
Fort Benning ....	3	4	1	1						
Barbour .....					4	4				
Blue Spring .....		4	1		3					
Fred T. Stimpson					1	13	14	8	5	1
Baldwin County ..					2	4			1	
Rob Boykin .....					1	4	1			1

TABLE 2—NUMBER OF FAWNS PER DOE IN EACH AGE CLASS, AVERAGE PRODUCTION PER DOE, AND SEX OF FETUSES WHEN IT COULD BE DETERMINED. SIZE OF SAMPLE IS GIVEN IN PARENTHESES.

Area	1 yr. old	2 yrs. old	3-6 yrs. old	7 & over	Av. Prod. Sex of Fetus	
					Male	Female
Lauderdale .....	0(3)	1.3(3)	2.0(6)		1.8	7 9
Thomas .....	0(4)	1.0(2)	1.4(5)	1.0(2)	1.2	
Black Warrior ...	1.0(2)	1.7(3)	2.0(11)	2.0(1)	1.8	6 6
Choccolocco .....	0(1)	.5(11)	1.6(25)	1.0(1)	1.4	14 18
Westervelt .....	0(7)	.8(10)	1.9(36)	1.8(6)	1.7	32 26
Sumter Farms ...	0(14)	.8(33)	1.6(68)	1.5(19)	1.4	50 38
Fort Benning ....	1.0(1)	1.5(6)	2.0(2)		1.6	6 8
Barbour .....	0(3)	2.0(2)	2.0(6)		2.0	5 7
Blue Spring .....	0(2)	2.0(2)	1.8(5)	2.0(1)	1.9	6 2
Fred T. Stimpson	0(7)	.5(8)	1.3(31)	1.2(6)	1.2	23 18
Baldwin Co. ....		.5(2)	1.4(5)	1.0(1)	1.1	
Rob Boykin .....	0(4)	.8(4)	2.0(3)	1.0(1)	1.2	5 5

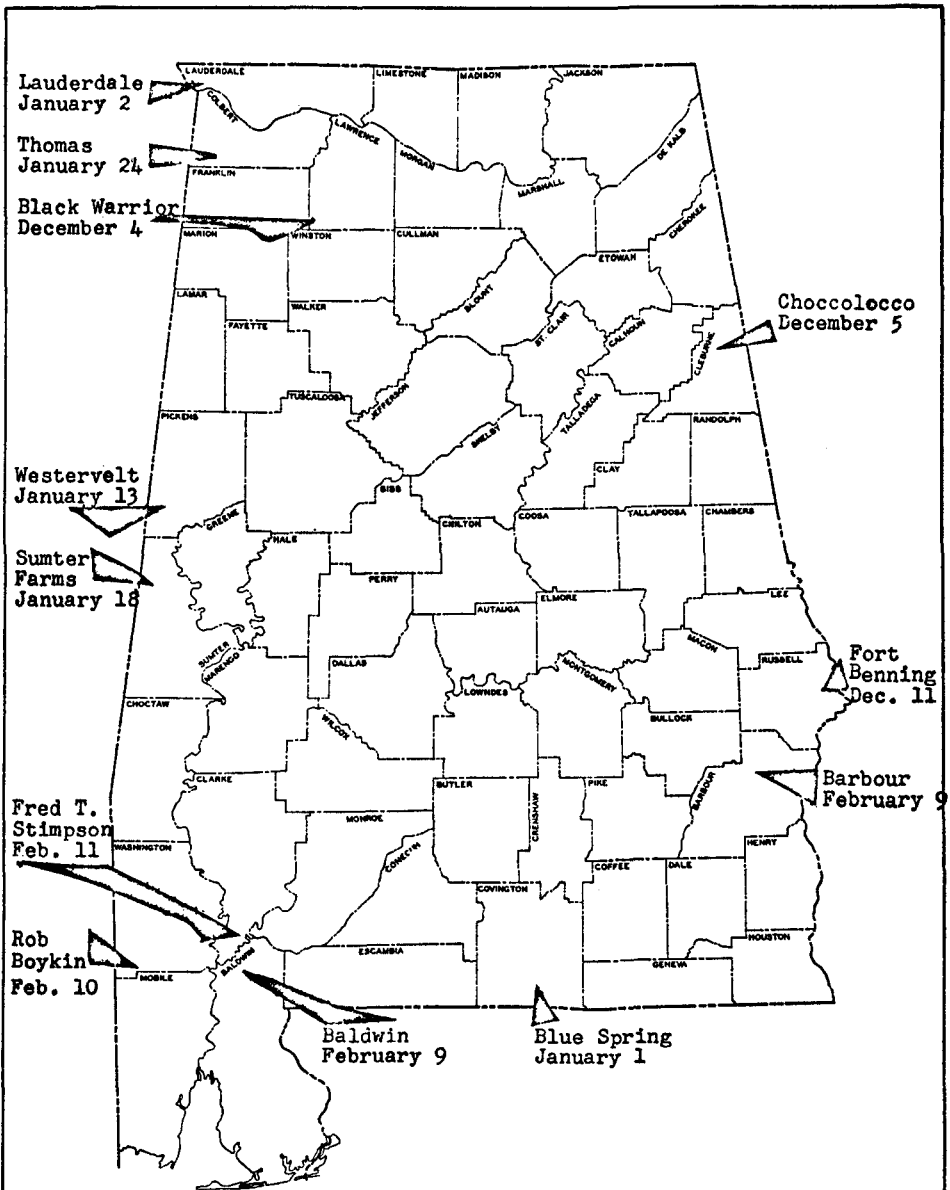


Figure 1. Map showing areas of study and average conception dates on those areas.

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The Lauderdale Management Area was stocked in 1955-56 with 32 deer from the State sanctuaries in Clarke County, and with 20 from Wisconsin. The average conception date was January 2, but it should be noted that the does from road kills of two separate years averaged conception dates that were twenty days later than those collected. The average production was 1.8 fawns per doe with all females of three years and older producing twins.

The Thomas Management Area was stocked in 1944-45, 1945-46, and 1949-50 with deer from Clarke County. It is less than fifty miles due south of the Lauderdale Area and the average breeding date was January 24. Production was 1.2 fawns per doe; however, some early collecting may be responsible for the low production. Only one of twelve illegally killed does (killed in November and December) was pregnant. Only one of five animals collected in early January was pregnant. Six of the seven adult does collected in mid-February had conceived.

The Black Warrior Management Area is east and a little south of Thomas. A group of 105 deer were imported from Iron Mountain Michigan in 1925-26, and fifteen Clarke County deer were stocked in 1949-50, following a high mortality in the summer and fall of 1949. Eight of 20 illegal November-December kills were pregnant. Collections included 10 females, two of which were pregnant fawns. The average date of conception was December 4; however, if the fawns were excluded, the breeding date would have been November 25. Average production was 1.8 even using the young does as active breeders.

Across the state eastward, and a little to the south, is Choccolocco Management Area. It was stocked with at least 76 animals from Pisgah, North Carolina, during a period from 1938 through 1941, and with seven specimens from South Alabama which were planted in 1939-40. The collections by Adams (op. cit.), plus two for this study, and some illegally killed specimens provided thirty-three usable reproductive tracts. The average fawning date was December 5 and the production was 1.4 per doe. A number of does in the two-year-old class were without fawns, even when collections were made late in the season.

On the west side of the State, almost midway from north to south, is Gulf States Paper Corporation's Westervelt Preserve. It is a hardwood-pine forest used for special company sponsored deer hunts. The stock appears to be remnants of an original herd. Average conception date of all years was January 13 and production was 1.7. There was considerable difference in time of conception during the years of study. Of the 45 pregnant does examined, there were seven sets of triplets and one set of quadruplets.

Less than thirty miles to the south is Sumter Farms, a privately owned farm-forest-wildlife area, with stock which appear to be descendants of the original herds of the area. Severe damage to farm crops occurred in 1959 and 1960 and the State trapped and removed nearly 600 deer from this area in the period 1960-61 through 1962-63. The average breeding dates peaked at January 18, and production was 1.4 per doe. Again, there was considerable variation between years. Of 100 pregnant does, there were three sets of triplets and one set of quadruplets.

One collection was made at Fort Benning on the Georgia-Alabama line. Animals were taken in both states as a cooperative study with the Georgia State Game & Fish Commission. This herd is apparently the result of plantings in Georgia. Average conception date was December 11 and production was 1.6. The sample was weighted toward young does. This collection produced another pregnant doe that was less than one year old.

The Barbour County Management Area is southwestward from Fort Benning. Eight adult female animals were sacrificed, all of which were approaching two or three years of age, and eight would have produced twins (production was 2.0). The estimated average conception date was February 2. The original stock for this area came from Clarke County in 1953-54 and 1954-55.

The Blue Spring Management Area is in the mid-southern portion of the State and is nearer Florida than any other area tested. Twenty-five animals from Texas were introduced in 1950-51, and 25 animals were moved from Clarke County in 1951-52. Only eight usable reproductive tracts were examined. Two of these animals had produced fawns by June 3. Conception was estimated to have occurred about January 1 and the production was 1.9 per doe.

Deer for restocking purposes in Alabama have been taken primarily from the Fred T. Stimpson Sanctuary. Tracts of 59 animals collected in four different years from this sanctuary and from the nearby Choctaw Bluff Hunting Club were examined. The average estimated conception date was February 11 and production was 1.2 per active doe. One two-year-old female, collected on August 19, showed evidence of recent ovulation (eruption site and a single corpora lutea) but was not included in the tables or in figuring conception.

Two additional collections were made on hunting clubs in north Baldwin County. One was on Carney Lumber Company lands and the other at Fort Pierce. The Conception date of the two similar areas was February 9 and the production was 1.1 fawns per doe. Forty tracts from these and adjoining areas collected in December, 1965 during the first hunter's choice season in the State did not show any pregnancies, in fact, few had well-developed eggs.

The Rob Boykin Management Area in southwest Alabama has remnants from the original deer of the area. Eight adult animals were taken for study. The average conception date was February 10 and the production was 1.2 fawns per doe. However, it should be stated that on this area one-half of the adult does taken were only two years old.

*Possible causes for variance in time and production:* It had been demonstrated that there is considerable variation between herds both in dates of conception and in production. There are probably many causes for these variations and they are very hard to treat statistically because of the small samples and variances within the samples.

*Time of collection:* One possible cause of variation is the time of fetal development represented in the sample. This could be called an "error of technique." By comparing collections taken the same year on the same area but in different months, it should be possible to determine if the techniques used gave the same birth dates, regardless of the time of year of collection or the development of the fetus. There were four years at Sumter Farms and three years at Fred T. Stimpson-Choctaw Bluff when two or more collections were made in one year. There were no significant differences between collections on the same area and in the same year as long as the system used by Armstrong (op. cit.) could be employed. However, in those reproductive tracts where the development had not progressed far enough so that the embryo could be measured there was a distinct tendency to give earlier conception dates. This was caused by eliminating nonpregnant animals from the sample, and by underestimating the time required for the implantation of the embryo. Of the study areas covered in this paper, only the Thomas Management Area might have a conception date that was estimated earlier than it really should have been.

When comparative studies (same areas and years) could be made, there were no differences in the production figures caused by the time of collection.

*Differences between years:* Weather, or some other factor, could cause differences between years. Although January 13 is given as the average conception date for Westervelt, there was considerable variation. It was January 23 in 1960, December 27 in 1961, January 3 in 1962, January 7 in 1963, January 20 in 1964, January 29 in 1965, January 11 in 1966 and January 25 in 1967. The earliest conception for all years was December 14 in 1961, and the latest was February 12 in 1965. There were 41 days between the earliest conceptions and latest conceptions in any one year (1966). Ninety-four percent of the breeding occurred within fifteen days before or after the average date for a given year. Two-thirds of the breeding for all years occurred in January.

Although Sumter Farms was less than 30 miles south of Westervelt, the conception dates were different. For Sumter Farms, January 18 is given as the average conception date, but it was January 9 in 1961, January 27 in 1962, January 17 in both 1963 and 1964, January 19 in 1965 and January 15 in 1966. The earliest conception was December

23 in 1961 and the latest was March 5 in 1964. There were 51 days between the earliest and latest conception for any one year (1965). Seventy-nine percent of the breeding occurred during the month of January.

For the Fred T. Stimpson Sanctuary, the overall average conception date was February 11, but it was February 16 in 1961, February 3 in 1962, February 19 in 1964 and February 9 in 1965. There were no collections in 1963. The earliest conception was January 5 in 1965, and the latest was March 21 in 1964. The greatest spread in any one year was 64 days in 1964. Fifty-two percent of the breeding occurred in February, thirty-four percent in January, and fourteen percent in March.

Attempts to relate the early or late breeding season with some weather factor were unsuccessful. Westervelt and Sumter Farms should have similar weather factors, but they did not have similar patterns of early or late breeding seasons.

In no case could significant differences in production be demonstrated between years. When differences did occur, it was usually because either an extreme number of young (two-year-old) or old (six-year-old or more) animals made up the majority of the sample. It should be noted that even though the table indicates that many old animals produced only one fawn, these animals were usually from areas of high populations.

*Differences between herds of different population densities:* Low production occurred in many of the samples and these were considered to be areas of overpopulations. At first it was thought that low production and late breeding were related. However, Barbour County had a February breeding peak and very good production. Sumter Farms was heavily overpopulated in the year of its earliest births. While there was an apparent tendency to have a greater spread in conception dates in areas and years of high populations, this could not be demonstrated statistically.

*Differences between age of does:* In three cases where does would have produced young soon after their first birthdays, conceptions were among the latest for that locality. Two extremely late conceptions were of this age class and found among highway kills in other parts of the state. The one-year-old class conceives and gives birth to fawns later than the older classes. There was no evidence that extremely early or extremely late births could be correlated with any other age class.

*Differences in stock:* Where out-of-state deer were used for initial stocking of an area (Black Warrior, Choccolocco, and Fort Benning), breeding occurs earlier than resident herds or those stocked from within the state. Deer herds resulting from mixed stocking (Lauderdale & Blue Spring) had intermediate breeding dates.

*Sex ratios:* Sex ratios of the fetuses are given in Table 2. The overall average of 52.6% bucks and 47.4% does appears to favor the hunter, but it is not significantly different than a 50/50 ratio.

## CONCLUSION

There is considerable variation in the breeding dates between the various deer herds of the state. Breeding may start as early as November 10 in some herds while the earliest date in other herds is January 25. Breeding may terminate in some herds before January 15 or continue through late March in others. Conception dates may be influenced by some climatic or other unknown factor, but are probably determined most by the genetic stock. Production per adult doe varied from 1.1 or 1.2 in the Baldwin-Clarke County area to 2.0 at Barbour. For the most part, recently stocked or heavily harvested areas had the best production. No evidence of unusual sex ratios were found.