Reproductive Performance and Condition of White-Tailed Deer in Ohio[1]

ROBERT J. STOLL, JR. and WILLIAM P. PARKER[2], Ohio Department of Natural Resources, Division of Wildlife, New Marshfield, OH 45766-9990

ABSTRACT. Information on reproductive performance and body condition in white-tailed deer (*Odocoileus virginianus*) was obtained in 1981-83 for the glaciated farmland and unglaciated hill country regions of Ohio. Uterine analysis of 275 farmland does and 129 hill country does showed that farmland fawns had a higher reproductive rate (0.85 fetus/doe) than did hill country fawn does (0.62 fetus/doe). Fetuses:doe ratios for yearlings (farmland = 1.89, hill country = 1.84) and adults (farmland = 1.85, hill country = 1.78) were similar and did not differ between regions. Most (>75%) pregnant fawn does carried only one fetus; most (>70%) yearling and adult does carried twins or had triplets. Fetal sex ratios differed from the expected 50:50 only for adult does from the farmland region (40% male fetuses). Does from Ohio's farmland region were consistently and significantly heavier, and yearling males had larger average antler beam diameter and more points than deer of the same sex and age from the hill country region. Body weights, antler characteristics, and reproductive rates for Ohio are typical of deer on a high nutritional plane, allowing white-tailed deer in both regions to approach full reproductive potential. A representative 100 does in the farmland and hill country regions could produce 147 and 140 fetuses, respectively. Because of regional age structure differences, a representative 100 deer of both sexes could produce 83 fetuses in both regions.

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INTRODUCTION

Information on reproductive performance and body condition in white-tailed deer (*Odocoileus virginianus*) is useful for monitoring deer herd welfare and for assessing the condition of the habitat or range available to deer. Additionally, data on reproductive performance are useful in estimating population size and establishing harvest quotas (Harder 1980).

Earlier reports of reproductive performance in Ohio white-tailed deer stemmed from collections in 1951 (Gilfillan 1952) and the early to mid-1960s (Nixon 1971). Since then, sizable increases have occurred in deer numbers and in forest cover. Hunter harvests currently in excess of 50,000 deer are about 10 times higher than those in the 1950s and 1960s. Commercial forest land increased 615,000 ha (28%), mostly in the eastern hill country, between 1952 and 1979 (Dennis 1983). Age and nutritional status of the does and possibly population density are the main factors affecting reproductive performance (Harder 1980, Ozoga and Verme 1982). This paper provides an estimate of the reproductive performance of Ohio white-tailed deer based on present habitat conditions and populations, and compares current Ohio reproductive rates and body condition estimates with those from the mid-1960s and those from nearby states.

METHODS

Information on deer reproductive performance and condition was obtained for the two distinct physiographic regions in Ohio: the glaciated and heavily farmed western and northeastern farmland region, and the unglaciated, moderately to heavily forested east-central and southeastern hill country region. The farmland region is only about 13% forested (Dennis and Birch 1981) and sparsely populated with deer (about 1-4/section, Division of Wildlife, unpublished records). The hill country region averages 51% forest cover (Dennis and Birch 1981) and is more densely populated with deer (about 4-15/section, Division of Wildlife, unpublished records).

Information on reproductive performance was obtained by uterine analysis of road-killed does in February, March, and April, 1982 and 1983. The date and number and sex of fetus(es) in each road kill were recorded, and the lower jaw of the doe was also collected. Samples were obtained from 75 of the 88 counties in Ohio.

Information on deer condition was obtained from check stations operated during the 1981 and 1982, 6-day (Nov.-Dec.) deer gun seasons in counties representative of the farmland and hill country regions. Hog-dressed weights (all viscera excluded) were taken on standard platform scales to the nearest 0.2 kg for deer of any age and sex. Antler characteristics (beam diameter and number of points) were obtained for 1.5-yr-old-males. The beam diameter of each antler was measured to the nearest 1 mm with a vernier caliper held 25 mm above the "burr", and averaged. The total number of points at least 25 mm long from the edge of both beams was also recorded.

Each deer was assigned to one of three age classes (i.e., fawn, yearling, adult) based on tooth replacement and wear criteria of the mandibular teeth (Severinghaus 1949). This technique is accurate for assigning age up to 1.6 yr; thereafter, it becomes more subjective (Roseberry 1980).

Fetal counts, body weights, beam diameters, and the number of antler points in the two physiographic regions were compared with *t*-tests. Pregnancy rates and fetal sex ratios were compared with a *z*-statistic (Freund et al. 1960). For deer of the same age class and region, there were no significant ($P > 0.05$) differences in reproductive performance or condition between years or among months of collection. Therefore, information from all sampling periods was combined.

RESULTS AND DISCUSSION

REPRODUCTIVE PERFORMANCE. A total of 404 does were examined for fetuses, 275 from the farmland region and 129 from the hill country region (Table 1). The percent of pregnant does and the number of fetuses per pregnant doe for the fawn age class were significantly ($P \leq 0.01$) lower than for yearling and adult does from the same region. About 68% of farmland fawn does and 51% of hill country fawn does were pregnant, with averages of 1.25 and 1.21 fetuses per pregnant doe, respectively. In contrast, virtually all (96%-100%) yearling and adult does from both regions were pregnant and averaged over 1.80 (range: 1.83-1.96) fetuses per pregnancy.

Farmland fawns had a higher reproductive rate (0.85 fetus/doe) than fawn does from the hill country

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[2]Present address: Rt. #3, Box 217, Athens, OH 45701.

region (0.62 fetus/doe), mainly because of the higher pregnancy rate among farmland fawns. Reproductive rates for yearling and adult does did not differ ($P > 0.05$) between regions. They ranged from a low of 1.78 fetuses/doe for hill country adults to a high of 1.89 fetuses/doe for farmland yearlings (Table 1). Current reproductive rates for fawn, yearling, and adult does appear somewhat lower than those recorded in the 1960s (Fig. 1). Most of this decline appears in the fawn age class in 1982-83 (farmland = 0.85 fetus/doe; hill country = 0.62 fetus/doe) compared to the 1960s (0.99 fetus/doe). Reproductive rates from the 1960s, however, are not directly comparable with those from 1982-83. Those from the 1960s were based on ovulation rates which are typically higher than those based on pregnancy rates because of ovum loss between ovulation and implantation (Nixon 1971). Nixon found an ovum loss of 13.3% for fawns and 11.5% for all age classes from ovulation through about three months of pregnancy. Roseberry and Klimstra (1970) reported ovum losses of 21.4% for fawns and 12.6% for older does in a southern Illinois deer herd. Thus, differences between the 1960s and 1982-83 are probably less than those shown in Figure 1. Although data from the 1960s were not broken into regions, Nixon (1971) noted that does from western Ohio ovulated and conceived at a slightly higher rate than does from eastern Ohio. He attributed this difference to the large amounts of agricultural crops available to western Ohio deer.

Most (>75%) pregnant fawn does carried only one fetus, and 21-25% carried twins (Table 1). Most (>62%) of the yearling and adult does carried twins, and 8-11% carried triplets. Collections made in the 1960s contained three does with four fetuses each and one with five fetuses (Nixon 1971).

Fetal sex ratios (Table 1) differed from the expected 50:50 only for adult deer from the farmland region (40% male fetuses, $P \leq 0.05$). Fetal sex ratios for the remaining age classes ranged from 55.9 to 47.1% male fetuses. In the 1960s, fetal sex ratios were highly skewed in favor of males, ranging from 63.7% for fawn breeders to 53.6% for adult breeders (Nixon 1971). An excess of male fawns may be expected in herds of low density or scattered distribution (Verme 1983). In the 1960s, the white-tailed deer population in Ohio was certainly low compared to that in 1982-83.

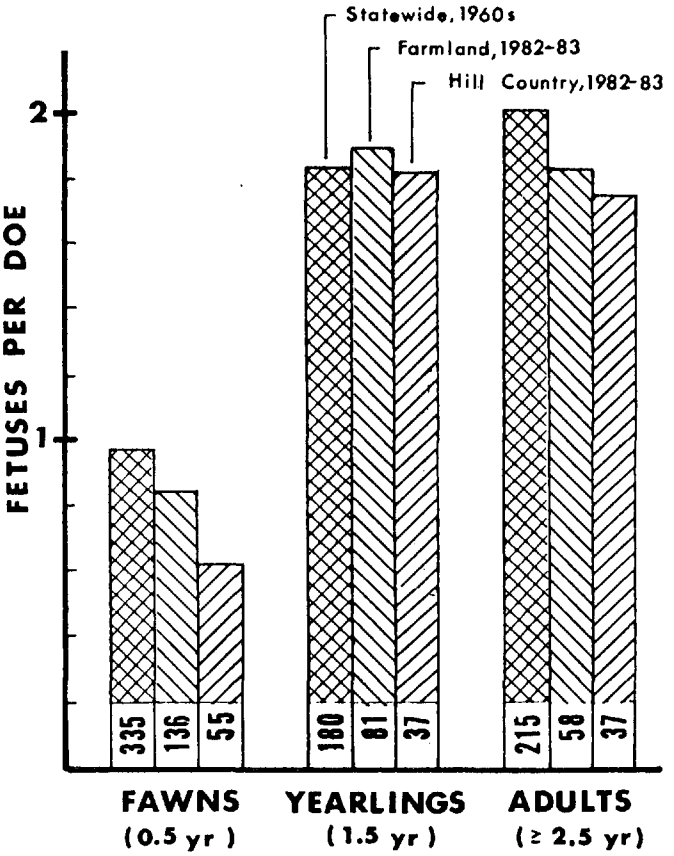

FIGURE 1. Histograms showing the number of fetuses per doe for fawn, yearling, and adult white-tailed deer. The period of 1982-83 is compared with the 1960s. The 1982-83 data are based on pregnancy rates; those from the 1960s (Nixon 1971) are based on ovulation rates which may account for the higher reproductive rates in the 1960s (see text). Sample sizes are at the bottom of the bar graphs.

Table 1

Reproductive performance of white-tailed deer by doe age class for the farmland and hill country regions of Ohio, 1982-83. Total numbers of sexed fetuses are in parentheses.

Breeding age of does	Number of does	Percent does pregnant	Mean no. fetuses per doe	Mean no. fetuses per pregnant doe	Does carrying 1, 2, & 3 fetuses			Percent male fetuses
					1	2	3	
Fawn, 0.5 yr*								
Farmland	136	68.4**	0.85**	1.25	70	23	0	55.9(111)
Hill country	55	50.9	0.62	1.21	22	6	0	47.1(34)
Yearling, 1.5 yr								
Farmland	81	96.3	1.89	1.96	10	61	7	52.9(153)
Hill country	37	100.0	1.84	1.84	10	23	4	47.1(68)
Adult, ≥2.5 yr								
Farmland	58	96.6	1.85	1.91	11	39	6	40.0***(105)
Hill country	37	97.3	1.78	1.83	9	24	3	48.4(62)

*Percent does pregnant, fetuses per doe, and fetuses per pregnant doe were significantly ($P \leq 0.01$) less for fawns than for yearlings and adults from the same region.
**Significantly ($P \leq 0.05$) different from hill country for same age class.
***Significantly ($P \leq 0.05$) different from expected 50:50.

Verme (1983) reviewed the literature on deer reproduction and found that the proportion of male fetuses declined with increasing fecundity of does (yearling and adults combined) older than one year. A regression equation for this relationship predicted a 50:50 fetal sex ratio at a reproductive rate of 1.64 fetuses/doe older than one year. Our data support Verme's observation, as reproductive rates for both Ohio regions exceeded 1.64 fetuses/doe, and fetal sex proportions were less than 50% male fetuses for the combined yearling and adult age classes. Verme (1983) also noted that doe fawns bore a preponderance (62.5%) of male fetuses, followed by progressive declines in yearling and adult (2.5-7.5 yr) does. Our reproductive data for the farmland follow this pattern, but the hill country data do not (Table 1). However, samples of fetuses in the hill country, especially for doe fawns (N = 34 fetuses), were small.

BODY CONDITION AND COMPARISONS WITH OTHER AREAS. Does from the farmland region of Ohio were consistently and significantly ($P \leq 0.05$) heavier, and yearling males had larger average beam diameters and more points than deer of the same sex and age from the hill country of Ohio (Table 2). Weight and antler characteristics vary with the nutritional level of the population (e.g., Hesselton and Sauer 1973, Severinghaus 1979). Nixon et al. (1970) found that deer from the farmland region had a somewhat higher annual nutritional plane than deer from the hill country region.

Reproductive rates for does from the farmland and hill country regions of Ohio compare favorably with those for deer from other areas where range conditions are good (Table 2). The reproductive rates for Ohio fawn does are among the highest reported for white-tailed deer. Similarly, dressed weights, antler beam diameters, and antler

TABLE 2

Reproductive rates and hunting season hog-dressed weights (all viscera excluded) for fawn, yearling, and adult does, and antler characteristics for yearling male white-tailed deer from Ohio and nearby states. Numbers in parentheses are sample sizes. Statistical comparisons were made only for Ohio farmland and hill country deer.

Area, (Reference), range condition, years data collected	Fawns (0.5 yr)		Yearlings (1.5 yr)		Adults (≥2.5 yr)		Yearling males (1.5 yr)	
	Fetuses per doe	Avg. wt. (kg)	Fetuses per doe	Avg. wt. (kg)	Fetuses per doe	Avg. wt. (kg)	Avg. beam diameter (mm)	Avg. no. points
Ohio (this study)								
Good range (farmland), 1981–83	0.85* (136)	31.3* (209)	1.89 (81)	48.1* (152)	1.85 (58)	53.9* (163)	24.6* (356)	6.3* (343)
Good range (hill country), 1981–83	0.62 (55)	29.2 (257)	1.84 (37)	44.4 (257)	1.78 (37)	48.0 (292)	23.0 (2,656)	5.9 (2,625)
Michigan**								
Good range (Region III, farmland)	0.65 (1,021)	— —	1.85 (451)	— —	1.94 (699)	— —	21.8 (997)	— —
Food shortage area (Region II)	0.09 (602)	— —	1.28 (550)	— —	1.69 (1,135)	— —	16.8 (1,070)	— —
Minnesota (J. Ludwig, personal communication)								
Good range (Prairie Manage. Unit, farmland), 1978–79	0.46 (<224)◆	28.9 (66)	1.41 (<224)◆	45.0 (40)	1.91 (<224)◆	52.1 (66)	22.2 (178)	5.7 (205)
Missouri (N. Giessman, personal communication)								
Good range (NE Riverbreaks, farmland), 1980–83	0.50 (30)	29.0 (213)	1.82 (11)	44.3 (214)	1.75 (20)	48.8 (275)	23.1 (875)	5.8 (900)
Fair range (Ozarks), 1980–83	0.48 (31)	20.0 (39)	1.56 (18)	34.1 (34)	1.65 (26)	38.0 (74)	16.7 (192)	3.3 (193)
New York (Hesselton and Sauer 1973)								
Good range, 1965, 1967	0.42 (90)	29.9 (80)	1.79 (83)	43.5 (71)	1.99 (155)	49.0 (130)	20 (66)	6 (67)
Poor range, 1965–67	0.06 (173)	25.4 (175)	1.38 (158)	41.3 (132)	1.80 (355)	47.6 (297)	16 (181)	3 (181)
Pennsylvania (W. Shope, personal communication)								
Good range, 1980	0.39 (28)	— —	1.62◇ (40)	— —	1.62◇ (40)	— —	20.6 (248)	5.0 (229)
Poor range, 1980	0.19 (36)	— —	1.27◇ (55)	— —	1.27◇ (55)	— —	17.6 (?)	3.7 (?)

*Significantly ($P \leq 0.05$) different from hill country mean.
**Productivity data for 1951–80 (Friedrich and Burgoyne 1980); beam diameters for 1979 (Burgoyne et al. 1980).
◆Sample size is for fawn, yearling, and adult does combined.
◇Fetuses per yearling and adult does combined.

Table 3
Gross recruitment to the Ohio farmland and hill country white-tailed deer herds, based on representative samples of 100 females and 100 deer of both sexes.

Population	Farmland			Hill country		
	Number of does	Fetuses per doe	Total fetuses	Number of does	Fetuses per doe	Total fetuses
Representative 100 females:						
Number of fawns	40	0.85	34	34	0.62	21
Number of yearlings	30	1.89	57	29	1.84	53
Number of adults	30	1.85	56	37	1.78	66
Total fetuses per 100 females			147			140
Representative 100 deer:						
Number of females per 100 deer	56			60		
Number of fawn females	22	0.85	19	21	0.62	13
Number of yearling females	17	1.89	32	17	1.84	31
Number of adult females	17	1.85	32	22	1.78	39
Total fetuses per 100 deer			83			83
Theoretical rate of increase			83%			83%

points for Ohio deer typify white-tailed deer populations on good range.

Reproductive performance, weight, and antler beam diameter are tied to the nutritional plane available to deer. Hesselton and Sauer (1973) concluded that female fawns in New York had to achieve a threshold dressed weight of 29.5 to 31.8 kg before breeding occurred. The average dressed weight (31.3 kg, Table 2) of Ohio farmland fawns is well within this threshold, and that (29.2 kg, Table 2) for hill country fawns closely approaches it. These average Ohio fawn weights are consistent with the 68% and 51% fawn pregnancy rates shown in Table 1 for farmland and hill country does, respectively. In New York, an average antler beam diameter of 15 mm for yearling males is associated with the absence of fawn breeding, whereas diameters in excess of 22 mm are associated with fawn reproductive rates in excess of 0.6 fetus/doe (Severinghaus and Moen 1983). In the present study, farmland and hill country yearling beam diameters averaged 24.6 mm and 23.0 mm, respectively. These values corresponded to high fawn reproductive rates of 0.85 and 0.62 fetus/doe. Breeding rates of yearling does are more sensitive to range conditions than breeding rates of fawn and adult does (Severinghaus and Moen 1983). In Ohio, the reproductive performance of yearling does is essentially the same as that for adult does (Table 1). Severinghaus and Moen (1983) also noted: "When range conditions are excellent and antler beam diameters are the largest, yearlings conceive at nearly the same rate as adults . . . Under such conditions, an ample supply of nutrients allows them to reach the full reproductive potential of which they are genetically capable."

RECRUITMENT. Recruitment, or gross natality as used here, is the total number of fetuses produced in a representative Ohio white-tailed deer population. The representative population was derived from three years (1980-82) of age structure data obtained from an approximately 10% gun harvest sample totaling nearly 20,000 deer. Despite this large sample, the age structure data are probably subject to the biases imposed by hunter selectivity and differences in deer behavior. Recruitment is shown in two different forms (Table 3): 1) number of fetuses produced by a representative population of 100 females; and 2) number of fetuses produced by a representative population of 100 deer (males and females).

In well nourished herds, counts of fetuses can be projected to live births (Harder 1980). Thus, projected totals of 147 and 140 fawns would be born to a representative 100 females in the farmland and hill country regions, respectively. Based on a representative population of male and female deer, this represents a theoretical population increase of 83% in both regions from pre- to post-fawning. Gilfillan (1952) calculated a theoretical rate of population increase of 72% for the northeast Ohio herd; Nixon (1971) calculated a 74% theoretical rate for the statewide herd.

The rate of increase (83%) calculated in the present study represents gross recruitment (i.e., estimated for the moment of birth); the net recruitment (i.e., young added to the population each fall) is considerably less. From birth to six months of age, fawn mortality rates of 15 and 25% were estimated for the farmland and hill country regions, respectively (Division of Wildlife, unpublished report). These contrast with published fawn mortality estimates ranging from 8 to 27% for mixed agricultural and forested habitat in the East and Midwest (Huegel et al. 1985). Recruitment and mortality estimates indicate that the Ohio deer herd is capable of a net increase of about 50 to 65% from the pre-fawning period to the fall, pre-hunt period.

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