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Natality of Black-tailed Deer in McDonald State Forest, Oregon³

Abstract

Natality of black-tailed deer (*Odocoileus hemionus columbianus*) in McDonald State Forest was evaluated by examination of 147 reproductive tracts. Yearlings collected from November 1968 to May 1970 averaged 0.79 corpora lutea per doe and adults averaged 1.76. Yearlings collected during spring in 1969 and 1970 averaged 0.88 fetus per doe; adults averaged 1.61 fetuses per doe. Fetuses and corpora lutea were absent in fawns. The peak of breeding, established from ovarian examination in late fall, occurred from 1 to 16 November during both years of study.

Deer collected following a severe winter in 1968-69 had an index of condition based on kidney fat significantly lower than deer collected following a mild winter in 1969-70. The rates of ovulation and fetuses per doe following the more severe winter were lower than those following the mild winter, but the differences were not statistically significant. Apparent dates of breeding as estimated from embryonic development differed between 1969 and 1970. However, examination of ovaries collected in October and November could establish no difference between years in the timing of ovulation. The later estimate of dates of ovulation determined from embryonic development and reduced index of condition reflected poorer physical condition of the does and reduced growth of fetuses during the severe winter of 1968-69.

Introduction

The purpose of this report is to provide a record of changes in natality of black-tailed deer occupying the McDonald State Forest in Benton County, Oregon, during 1969 and 1970, and a record of relationships among weather, physical condition of the deer, and natality.

Description of the Study Area

McDonald State Forest (including Paul Dunn Forest) encompasses 5,171 ha of forested hills in the Coast Range approximately 11.3 km north of Corvallis, Oregon. Most of the area is 152-427 m above sea level; maximum elevation is 661 m.

McDonald Forest is in the hemlock (*Tsuga heterophylla*) vegetative zone described by Franklin and Dyrness (1969). The predominant community type is Douglas-fir/ocean spray (*Pseudotsuga menziesii*/*Holodiscus discolor*). The predominant soil type is "Red Hill" (Gartz, 1954), which occurs over much of the Coast Range. The stages of plant succession range from recently logged by the clearcutting method to subclimax vegetation. Eighty-four percent of the Forest is occupied by seral communities more than 30

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years old. Black-tailed deer generally occur in greatest density in seral communities less than 30 years old.

The climate is normally mild (U.S. Department of Commerce, 1969). Rainfall averages 1.02 m annually, and periodic summer drought is expected. Average temperature during January, the coldest month, is 4.1°C. Measurable snowfall at Corvallis occurs an average 83.5 days per year. Depth of snow on the ground rarely exceeds 5.1-7.6 cm at the lower elevations on the study area, and snow usually melts in one or two days.

Precipitation during December through February 1968-69 was 71.8 cm, snowfall totaled 78.2 cm, and the mean temperature was 2.9°C (Corvallis State College [sic] Weather Station, U.S. Department of Commerce, 1969, 1970). Values for 1969-70 were 84.0 cm of total precipitation, a trace of snow, and mean temperature of 5.8°C. Long-term normals for the reporting station were 44.9 cm precipitation, 15.4 cm snowfall, and mean temperature of 5.0°C.

Methods

Hunters were provided with a plastic bag and an illustration of the reproductive tract of female deer, and were asked to submit tracts from does for examination. Fifty-six pairs of ovaries were obtained during 1968, 16 in October, and 40 during November. Forty pairs were obtained during November 1969. Hunting of antlerless deer was not permitted during October 1969, but 11 does were collected from the area to provide a sample for comparison with the previous year.

Twenty does were collected in March-May 1969 and 1970, providing 40 reproductive tracts for examination during the later stages of gestation. Ovaries were sectioned at 1-mm intervals following brief storage in formalin and examined according to the procedure outlined by Trauger and Haugen (1965).

Mandibles were removed from deer brought to the checking station, except infrequently when a hunter objected. Jaws were marked, cleaned, and used to assign animals to fawn, yearling, and adult categories according to tooth replacement (Moreland, 1952). Jaws of adults were then separated comparatively into categories by degree of wear and assigned to age classes.

Both kidneys, with accompanying deposits of fat, and one femur were obtained from each deer in the March-May collections to appraise general physical condition. The ratio of kidney fat to kidney weight (Riney, 1955), color and texture of marrow from femurs (Riney, 1955), and compressibility of a 6.4-cm section of marrow (Greer, 1968) were used as indices of body condition of the deer.

Results

Only 25 percent (5/20) of the ovarian pairs from adult does obtained during October 1968 and 1969 had corpora lutea. However, 91 percent (62/68) of the adult does collected during November had ovulated. Because significantly fewer deer collected in October had ovulated as compared with those collected in November ($P < 0.005$; $X^2 = 40.13$; d.f. = 1), rates of ovulation in the fall were estimated from ovaries collected during November. No significant differences ($P > 0.93$; $X^2 = 0.14$; d.f. = 1) occurred between years in mean numbers of ovulations per doe collected during November. Average numbers of corpora lutea showed greater variability among yearlings than adults (Table 1).

TABLE 1. Average numbers of corpora lutea per doe (± 2 standard error) from deer collected in McDonald Forest, Benton County, Oregon. (Sample sizes in parentheses.)

Period of collection	Fawns	Yearlings	Adults
November 1968	0.00 (8)	0.89 \pm 0.47 ^a (9)	1.74 \pm 0.30 (23)
Spring 1969	0.00 (2)	0.67 \pm 0.54 (6)	1.75 \pm 0.48 (12)
November 1969	0.00 (8)	0.57 \pm 0.49 (7)	1.76 \pm 0.21 (25)
Spring 1970	0.00 (2)	1.50 (2)	1.81 \pm 0.35 (16)
Mean		0.77 \pm 0.25 (24)	1.76 \pm 0.32 (75)

^a The formula $L(u) = \pm t(.05) s$ (Snedecor and Cochran, 1956-76) was used to calculate standard errors provided in the tables.

The average number of fetuses per adult doe (Table 2) was slightly lower than the average number of corpora lutea per adult doe, but the confidence intervals overlapped.

TABLE 2. Average number of fetuses per doe (± 2 standard error) from deer collected in McDonald State Forest, Benton County, Oregon. (Sample sizes in parentheses.)

Period of collection	Fawns	Yearlings	Adults
1969	0.00 (2)	0.67 \pm 0.54 (6)	1.50 \pm 0.43 (12)
1970	0.00 (2)	1.50 (2)	1.69 \pm 0.32 (16)
Mean	0.00 (4)	0.87 \pm 0.53 (8)	1.61 \pm 0.24 (28)

The initiation and peak of the breeding season were determined from the appearance of corpora lutea in ovaries collected during the fall. The does in McDonald Forest began breeding in the last half of October and reached a peak in the first half of November (Table 3).

TABLE 3. Percentage of yearling and adult black-tailed deer which had ovulated by time of collection from McDonald State Forest, Benton County, Oregon. (Sample size in parentheses.)

Date of collection	Percentage having ovulated	
	1968	1969
October 17-25	14.3 (7)	14.3 (7)
October 26-November 7	28.6 (7)	66.7 (3)
November 8-10	94.1 (17)	87.5 (32)
November 16-17	93.3 (15)	—

Differences in Physical Condition Between Years. Only four of 39 deer examined had indices of kidney fat of 30 percent or greater (Fig. 1). Indices of condition based on kidney fat from deer collected in 1970, however, were significantly higher ($P > 0.025$; $X^2 = 10.18$; d.f. = 1) than the indices from deer collected in 1969 (Table 4).

TABLE 4. Numbers of deer collected in McDonald State Forest, Benton County, Oregon, in relation to index of condition with calculated expected frequencies in parentheses.

Year	Index of condition (percent)			
	4-7	8-12	13-17	18+
1969	9 (5.35)	6 (4.87)	3 (5.35)	1 (3.41)
1970	2 (5.65)	4 (5.13)	8 (5.65)	6 (3.59)

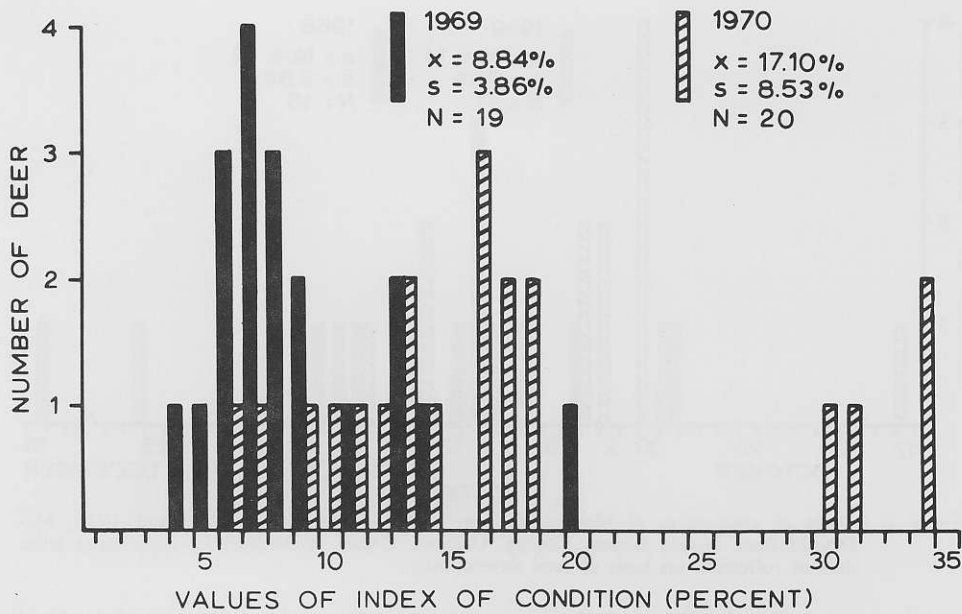


Figure 1. Indices of physical condition of deer collected March-May 1969 and 1970, McDonald State Forest, Benton County, Oregon. Index of condition equals weight of fat surrounding kidney \div kidney weight \times 100.

Rate of fetal growth may be used as an indicator of physical condition of the deer collected because rate of growth of the fetus depends on the level of maternal nutrition (Ommundsen and Cowan, 1970). We suggest that the earlier estimated dates of breeding based on fetal length in 1969 resulted from a faster rate of growth than that achieved by fetuses conceived in 1968 when the estimates of dates of breeding obtained by frequency of ovulation and fetal lengths overlapped. Faster rate of growth of a fetus would result in an earlier estimated date of breeding because the date of breeding was estimated from the length of the fetus. In 1968, 95 percent of the does were estimated on the basis of fetus length to have bred between 23 October and 2 December (Fig. 2), with a mean date of 14 November. In 1969, the mean date of conception was calculated, by the same method, as 4 November, with 95 percent of the does estimated to have bred between 19 October and 20 November. The estimated dates of breeding based on fetus length in 1969 were significantly earlier ($P < 0.025$; $X^2 = 9.42$;

TABLE 5. Groupings of black-tailed deer according to estimated dates of breeding, 1968-69, McDonald State Forest, Benton County, Oregon, with calculated expected frequencies in parentheses.

Year of collection	October 17-31	November 1-8	November 9-14	November 15+
1969	1 (3.3)	2 (3.75)	6 (4.7)	6 (3.3)
1970	6 (3.7)	6 (4.25)	4 (5.3)	1 (3.7)

d.f. = 1) than those in 1968 (Table 5). Because there were no apparent differences in the numbers of corpora lutea at the same time each fall (Table 3), actual dates of breeding were probably similar for 1968 and 1969.

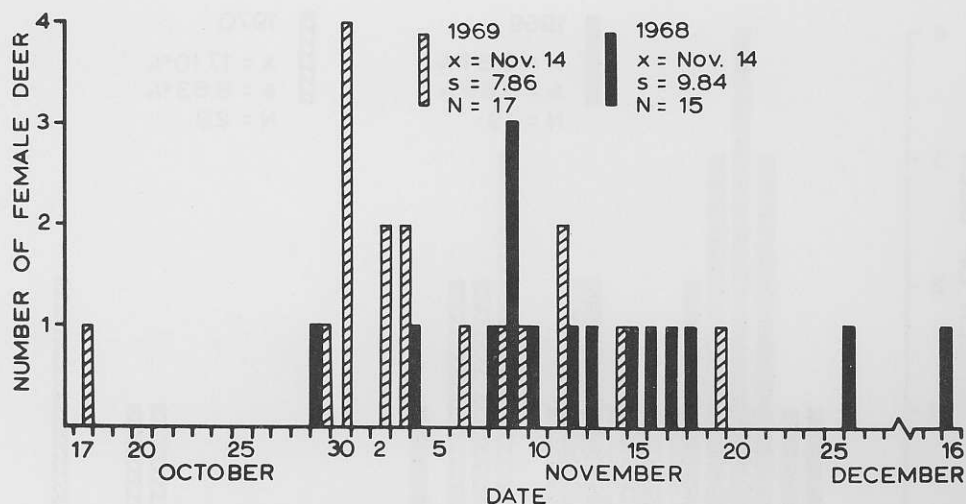


Figure 2. Dates of conception of black-tailed deer collected March-May 1969 and 1970, McDonald State Forest, Benton County, Oregon. Dates determined by backdating from date of collection on basis of fetal development.

The statistically significant differences in both indices of condition and in fetal growth rates between years support the hypothesis that deer collected in 1970 were in better condition than deer collected in 1969 following the harsh winter. The more rapid rate of growth exhibited by fetuses in 1969 would provide a larger and stronger fawn at birth.

Discussion

The rate of ovulation of adult does collected in McDonald Forest was midway between the lowest and highest rates of ovulation found by Bischoff among five herds of black-tailed deer in California (Table 6). The average number of corpora lutea found by

TABLE 6. Comparison of rates of ovulation among black-tailed deer herds in California, Washington, and McDonald State Forest, Oregon. (Sample sizes in parentheses.)

Authority	Corpora lutea per doe	
	Yearling	Adult
McDonald State Forest	0.79 (24)	1.76 (76)
Bischoff (1958)		
Tehama	—	1.91 (22)
Oak Knoll	—	1.54 (22)
Taber (1953)		
Recent Burn	0.67	1.75
Open Brush	1.00	1.89
Brown (1961)	1.15 (13)	1.57 (46)

Taber (1953) among deer collected from a recently burned area in California, which he considered fair range, was almost identical with the rate of ovulation from deer collected in McDonald Forest. Deer collected from open brush land, which Taber (1953) considered good range, had a slightly higher number of ovulations than deer collected from McDonald Forest. The number of ovulations per adult doe killed in

McDonald Forest was slightly higher than the number found at comparable times of year in western Washington (Brown, 1961). The rate of ovulation in McDonald Forest may have been influenced by the high average rate of harvest (34 per ha per year) over the past 19 years.

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Literature Cited

- Bischoff, A. I. 1958. Productivity in some California herds. *California Fish Game* 44: 253-259.
- Brown, E. R. 1961. The black-tailed deer of western Washington. Washington Game Dept. Biol. Bull. 13. 124 p.
- Caughley, G. 1966. Mortality patterns in mammals. *Ecology* 47: 906-918.
- Cheatum, E. L. 1949. The use of corpora lutea for determining ovulation incidence and variations in the fertility of whitetailed deer. *Cornell Veterinarian* 39: 282-291.
- Franklin, J. F., and C. T. Dyrness. 1969. Vegetation of Oregon and Washington. U.S. Dept. Agric. For. Serv. Res. Paper PNW-80. 216 p.
- Gartz, J. F. 1954. A management plan for the McDonald Forest. Oregon State Univ., Corvallis, M.S. thesis. 108 p.
- Greer, K. R. 1968. A compression method indicates fat content of elk (wapiti) femur marrows. *J. Wildl. Manage.* 32: 747-751.
- Hudson, P., and L. G. Browman. 1959. Embryonic and fetal development of the mule deer. *J. Wildl. Manage.* 23: 295-304.
- Moreland, R. 1952. Technique for determining age in black-tailed deer. *Proc. Western Assoc. State Game Fish Comm.* 32: 214-219.
- Ommundson, P., and I. McT. Cowan. 1970. Development of the Columbian black-tailed deer (*Odocoileus hemionus columbianus*) during the fetal period. *Can. J. Zool.* 48: 123-132.
- Riney, T. 1955. Evaluating condition of free-ranging red deer (*Cervus elaphus*), with special reference to New Zealand. *New Zealand J. Sci. Tech.* 36: 429-463.
- Senedecor, G. W., and W. G. Cochran. 1956. *Statistical methods.* Iowa State Univ. Press, Ames. 534 p.
- Taber, R. D. 1953. Studies of black-tailed deer reproduction on three chaparral cover types. *California Fish Game* 39: 177-186.
- Trauger, D. L., and A. O. Haugen. 1965. Corpora lutea variations of white-tailed deer. *J. Wildl. Manage.* 29: 487-492.
- U.S. Department of Commerce. 1969. Climatological data: Oregon 74(12): 219-249.
- . 1969. Climatological data: Oregon 75: 200-216.
- . 1969. Climatological data: Oregon 75: 217-253.
- . 1970. Climatological data: Oregon 76: 1-18.

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