PHYSICAL CHARACTERISTICS OF WHITE-TAILED DEER FAWNS IN SOUTHWESTERN OKLAHOMA

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Abstract: Eighty-three white-tailed deer fawns (*Odocoileus virginianus texanus*) were captured in the Wichita Mountains of southwestern Oklahoma between 1974 and 1977. General physical appearance was documented and 10 body measurements were taken from each fawn. The calculated age of captured fawns ranged from 1 to 21 days. Three measurements (total weight, total body length, and hind foot length) appeared to be those most descriptive of skeletal and body mass changes with increasing age. Regression models indicated that males were larger and grew faster than females. The rates of weight gain for male (0.28 kg/ day) and female (0.24 kg/ day) fawns were higher than previously reported.

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The classification of white-tailed deer into subspecies has been somewhat confused because of integration among subspecies, instability of characteristics, and the widespread transplanting of subspecies (Halls 1978:45). A majority of the white-tailed deer range in the southern United States was repopulated through stocking efforts (Barick 1951) over the past 40 years. In contrast, the deer in the Wichita Mountains of Oklahoma have continually maintained their numbers and are the descendants of the native subspecies *O.v. texanus* (Lindzey 1951, Halloran and Glass 1959). The Wichita Mountains population also has been isolated from other deer herds by extensive agricultural land surrounding the mountain complex (Garner et al. 1976), thereby limiting their integration with other subspecies. In 1974 we initiated an intensive research program investigating the fawn segment of this population, which enabled us to document various physical characteristics of this subspecies (Garner 1976, Bartush 1978).

The availability of information regarding physical characteristics and growth of free-ranging deer fawns is scarce. Some physical characteristics of wild mule deer (*O. hemionus*) fawns were documented by Robinette et al. (1977). Weight gain in a free-ranging population of white-tailed deer fawns in south Texas has been described (Knowlton, F.K., M. White and J.G. Kie. 1979, personal communication). To our knowledge all other information published on neonatal fawn growth deals with captive groups of deer. These studies of penned deer have indicated that general health, fawn survival and recruitment, nutritional environment, and other factors related to the fawn and its dam (Cowan and Wood 1955, Verme 1963, Murphy and Coates 1966, Verme 1969, Robinette et al. 1973, Verme 1977) may be better understood if baseline information on fawn growth exists within a given population. The purpose of this paper is to document physical characteristics of a native subspecies of white-tailed deer.

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STUDY AREA

The study area is located in Comanche County, southwestern Oklahoma on the contiguous 23,917 ha Wichita Mountains National Wildlife Refuge (WMNWR) and 38,164 ha Fort Sill Military Reservation (FSMR) (Garner et al. 1976). The mountain region rises 427 m above the surrounding plain and is mostly confined within WMNWR and FSMR (Bartush 1978). Topography varies from level prairies to rocky slopes exceeding 20%. The climate is regarded as temperate, continental, and of the dry-subhumid type with the average annual precipitation of 74.1 cm occurring primarily in the spring and summer (Soil Conservation Service 1967, 1970).

The principal habitat type is mixed grass prairie. Tall grasses such as big bluestem (*Andropogon gerardii*), Indiangrass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*) occur on moist deep soils and mid- or short grasses such as little bluestem (*Schizachyrium scoparium*), gramas (*Bouteloua* spp.), and buffalo grass (*Buchloë dactyloides*) predominate on more droughty sites. Woodland areas are confined to creek bottoms and rocky slopes where soils are sandy or gravelly. Principal tree species include post oak (*Quercus stellata*), blackjack oak (*Q. marilandica*) and eastern red cedar (*Juniperus virginianus*).

White-tailed deer are the primary big game species on FSMR, though a small number of elk (*Cervus canadensis*) are also present. Annual hunts for deer and elk are held on FSMR. WMNWR supports substantial numbers of white-tailed deer, elk, buffalo (*Bison bison*), and Texas longhorns within an 80 km long, 2.4 m high ungulate-proof fence. Annual population control mechanisms on WMNWR include auctions of buffalo and longhorn, and a controlled hunt to harvest elk. The deer population on WMNWR has not been regulated by man since deer trapping efforts ceased in 1965.

Deer density on the study area was estimated at between 6 to 10 per km^2 (Garner et al. 1976, G. Stout 1977, unpublished report, Division of Fish and Wildlife, Fort Sill Military Reservation). Fawn survival on both FSMR and WMNWR is low (Garner et al. 1976, Bartush 1978). Routine autumn fawn: doe ratios between 1974 and 1977 ranged from 14 to 45:100. The primary agent involved in the high mortality of fawns has been predation by coyotes (*Canis latrans*) and bobcats (*Lynx rufus*) (Garner et al. 1976, Bartush 1978).

MATERIALS AND METHODS

Fawns were captured in May and June of 1974 through 1977 using methods described by Downing and McGinnes (1969), White et al. (1972) and Garner et al. (1976). The method on this study area generally required observation of the fawn from high vantage points (mountains and military towers) and subsequent capture by the field crew. A second method involved estimating the time of birth of fawns from careful monitoring of radio-collared does (Bartush and Lewis 1978). This latter method enabled capture of most of the fawns less than 3 days of age. Another method used to a limited extent was observation of fawns from a helicopter and subsequent capture by a ground crew as described by Lund (1975).

After capture each fawn was carefully examined for abnormalities and physical condition. Sex, body measurements, condition of the navel, appearance and texture of the hooves, and fawn vigor were recorded on standard field forms. Measurements taken included weight, total length, head width, neck circumference, and tail, head, nose, ear and hind foot lengths. All measurements were taken on bone structures or definitive characteristics to eliminate additional variation.

The measurement, instrument used, unit of measure, and general procedure for each were as follows:

1. Weight - Dial scale (20 kg), fawn harnessed and weighed suspended. Harness weight subtracted from total.
2. Total length - Flexible cloth tape (cm), the length from extreme tip of nose dorsally over brain case and along midline of the vertebral column to the distal end of the last caudal vertebra.
3. Tail length - Flexible cloth tape (cm), measurement of caudal vertebra (from tail base distally to the end of the vertebra).
4. Head length - Flexible cloth tape (cm), from extreme tip of nose dorsally over the brain case to the occiput.
5. Nose length - Graduated rule (cm), from extreme tip of nose to tear duct of the eye.
6. Ear length - Graduated rule (cm), greatest length from inner notch at ear base to the uppermost pinna.
7. Head width - Calipers / graduated rule (cm), greatest width of brain case posterior of the zygomatic arches.
8. Neck circumference - Flexible cloth tape (cm), 3 measurements-circumference of neck just posterior to the atlas (head), circumference of neck just anterior to scapula (shoulder), and circumference midway between the previous measurements (mid).
9. Hind foot length - Flexible cloth tape (cm), length of foot held straight from tip of hoof to tip of calcaneous, right and left measurements were averaged.
10. New hoof growth - Calipers / graduated rule (mm), measured from the hairline on outside half of front hoof to the edge of growth ring on the hoof (Haugen and Speake 1958, Robinette et al. 1973).

Ages of fawns were determined primarily by measuring new hoof growth. Navel condition, texture of the hooves, and fawn behavior as described by Haugen and Speake (1958) and Robinette et al. (1973) were also helpful in aging fawns. Linear regression analyses were performed on all data. Regression models for males were compared to the corresponding models for females using the test for parallelism and the test for common intercept described by Kleinbaum and Kupper (1978). Groups of data were tested by standard t tests and regression models were tested for lack of fit (Draper and Smith 1966).

RESULTS AND DISCUSSION

Eighty-three fawns ranging from 1 to 21 days of age were captured, 10 in 1974, 25 in 1975, 20 in 1976, and 28 in 1977. Differences in the variables measured between years or between capture areas (FSMR and WMNWR) could not be tested due to the limited numbers of fawns in each age class. However, variation between years and sampling areas appeared to be random; therefore, data from all captured fawns were consequently grouped together for data analyses.

Variation was readily apparent between individual fawns within the age groups. Head width, neck circumference, and tail, head, nose, and ear lengths displayed such extreme variation (Bartush 1978:114) that further consideration in this paper appeared unnecessary. Body weight, total length, and hind foot length were the most consistent measurement of growth in fawns and were used in the data analyses. These measurements are believed to be more reliable when describing fawn growth, both in body mass and in skeletal size.

Initial size (at birth) and subsequent growth were influenced by sex of the fawn. Captured male fawns averaged 2.63 kg at one day of age (Table 1), whereas females weighed approximately 2.41 kg at one day of age (Table 1). Other studies have documented that males were larger at birth and exhibited faster growth than females (Verme 1963, Robinette et al. 1973, Robbins and Moen 1975). Statistical tests to

TABLE 1. Mean weight and length measurements of male and female fawns at various ages, Wichita Mountains, Oklahoma, 1974 through 1977.

Age (days)	Sample size M	Sample size F	Weight (kg) M X S.D.	Weight (kg) F X S.D.	Length (cm) Total M X S.D.	Length (cm) Total F X S.D.	Length (cm) Hind foot M X S.D.	Length (cm) Hind foot F X S.D.
1	6	3	2.63±0.49	2.41±0.17	61.9±5.61	60.7±5.9	21.9±1.2	22.0±1.0
2	1	1	1.63	2.36	50.5	63.8	18.6	22.4
3	1	5	2.94	2.67±0.34	59.8	63.8±2.1	23.7	22.6±1.2
4	1		3.1		62.6		23.5	
5		3		3.14±0.2		64.8±4.5		22.7±0.6
6	5	2	3.62±0.48	4.48±0.39	68.5±5.2	66.6±2.2	23.7±1.2	24.6±0.1
7	4	3	3.88±0.34	4.37±0.37	67.2±4.1	66.6±4.9	23.8±0.8	24.2±0.1
8	2	6	4.69±0.9	3.88±0.98	69.6±10.3	64.1±5.9	25.3±1.6	23.7±1.5
9	2	3	5.92±0.83	3.77±0.74	77.1±8.4	71.9±1.9	26.1±0.9	24.6±0.3
10	4	3	5.25±0.67	4.83±0.55	74.4±3.7	72.4±8.3	25.7±0.8	25.5±1.1
11	1	4	3.81	4.21±0.61	70.2	72.8±2.6	24.2	24.9±0.8
12	2	2	4.71±0.32	4.85±0.18	70.5±2.1	71.5±4.4	25.5±1.4	25.1±0.9
14	3	2	5.84±8.4	4.93±0.64	83.3±6.3	77.3±11.4	26.9±2.1	25.1±2
15	1	1	5.86	5.18	77.8	74.1	27.15	26.8
16		1		5.72		80.3		26.8
17	2	1	6.65±1.76	7.14	80.2±15.2	80.5	26.4±2.1	28.0
18	3	1	7.05±0.65	6.68	81.7±4.8	79.6	27.6±1.3	26.8
19	1		9.15		91.5		29.0	
20	1		7.54		84.5		29.0	
21	1	1	8.43	7.68	85.0	86.5	28.7	28.5

determine weight differences between males and females were limited to 7 age categories due to small or irregular samples in other age groups. Males were significantly ($P<0.05$) larger than females at 6, 7, and 9 days of age. This difference also existed at 1, 8, 10 and 14 days of age, though not significantly.

The following linear relationship between weight and age for captured fawns (both sexes) was statistically significant ($P<0.0005$).

$$Y \text{ (live weight)} = 2.0348 + 0.2681 \text{ X(age in days)} \quad R^2 = 0.7959$$

However, there was a significant lack of fit ($0.05<P<0.01$) in this model (Draper and Smith 1966). These data were then separated into sex classes and the relationship between live weight and age was examined. The resultant models were statistically significant for both males and females ($P<0.0005$ in both classes) and neither model had a significant lack of fit ($P<0.05$ in both cases). Therefore, subsequent data analyses were conducted, with the data from males and females being examined separately. Linear relationships between the various combinations of the 3 measurements (weight, total length, and hind foot length) were examined (Table 2).

Another difference observed between sexes in the regression models was that growth rates of male fawns tended to accelerate faster than females. The fitted regression line (Fig. 1) for male fawns substantiates the fact that males are heavier at birth and grew faster than female fawns (Fig. 2) between 0 and 21 days of age.

Both male and female fawns in this study had higher average daily weight gains than reported previously. Males and females exhibited growths of 0.28 kg/day and 0.24 kg/day, respectively through 21 days of age. Average weight gain for all fawns was 0.27 kg/day. These higher weight gains reflect mean daily growth of neonatal fawns (<21 days), a period when growth is known to be greater than in older animals (>21 days). For instance, other studies described slower weight gains (<0.25 kg/day) over longer periods (>21 days) of time (Murphy and Coates 1966, Thompson et al. 1973, Robbins and Moen 1975). This hypothesis is further documented by Russell et al. (1977) in that weight gains

TABLE 2. Linear regression equations ($P<<0.0005$) and the respective R^2 values for male and female fawns, Wichita Mountains, Oklahoma, 1974 through 1977.

Sex	Regression equation	
Male	[a]Y(live weight) = 2.12 + 0.28 (age)	$R^2 = 0.83$
Female	[a]Y(live weight) = 2.07 + 0.24 (age)	$R^2 = 0.77$
Male	[b]Y(total length) = 59.02 + 1.36 (age)	$R^2 = 0.66$
Female	[b]Y(total length) = 62.32 + 1.2 (age)	$R^2 = 0.61$
Male/Female	[c]Y(hind foot length) = 21.57 + 0.34 (age)	$R^2 = 0.72$
Male	Y(total length) = 3.36 + 2.75 (hind foot length)	$R^2 = 0.66$
Female	Y(total length) = -18.18 + 3.6 (hind foot length)	$R^2 = 0.77$
Male	Y(weight) = -7.29 + 0.17 (total length)	$R^2 = 0.83$
Female	Y(weight) = -5.91 + 0.14 (total length)	$R^2 = 0.66$
Male	Y(weight) = -12.75 + 0.7 (hind foot length)	$R^2 = 0.88$
Female	Y(weight) = -12.18 + 0.67 (hind foot length)	$R^2 = 0.82$

[a]Equations have a common intercept but are different slopes (nonparallel).
[b]Equations have a different intercept but are the same slope (parallel).
[c]Male and female equations pooled due to common intercept and the same slope.

of fawns <15 days of age were slightly greater than 0.25 kg/day. Verme (1963) found that smaller fawns born to does fed a nutritionally poor diet tended to grow faster than large fawns reared by does on a higher nutritional plane (compensatory gain). There is also the possibility that free-ranging fawns in their native environment may grow at faster rates than do captive individuals.

Total length and hind foot length were also found to be greater in males than females at the respective age groups. In total length male fawns grew approximately 1.36 cm/day while females averaged 1.20 cm/day. Hind foot measurements increased 0.36 cm/day in males and 0.31 cm/day in females. Other high correlations between weight and total length, weight and hind foot length, and total length and hind foot length were apparent. These correlations substantiate the idea that increases, both in skeletal size and in body mass, were consistent in this study and are directly related to growth rather than to individual variation.

If the aging technique is assumed to have been precise and consistent (Haugen and Speake 1958, Robinette et al. 1973), two hypotheses explaining the findings on growth rates could be stated: (1) the fawns were from does on a poor nutritional plane, they were small at birth and subsequently grew at proportionately faster rates (Verme 1963); or (2) fawns displayed a rapid growth rate because they are the native subspecies and are naturally adapted to the habitat. Nutrition did not appear to be a problem in the Wichita Mountains because: (1) ovulation and prepartum production were high in collected does (Garner et al. 1976; Hammond Eve 1976, unpublished report, Wichita Mountains National Wildlife Refuge Deer Herd in file Oklahoma Department of Wildlife Conservation); (2) 8 yearlings in 1976 averaged 2 corpora lutea per doe and there was evidence of fawns breeding (Stout, G.G. 1979. Fort Sill Deer Herd Analysis, Rept. in file Fish and Wildlife Administrator, Fort Sill Military Base, 18 p.); and (3) neonatal fawns necropsied during this study were in good to excellent condition. Also, there was no relationship between the size of a fawn at capture and its subsequent survival. Therefore, the second hypothesis is believed to explain the faster growth rates of fawns in the Wichita Mountains.

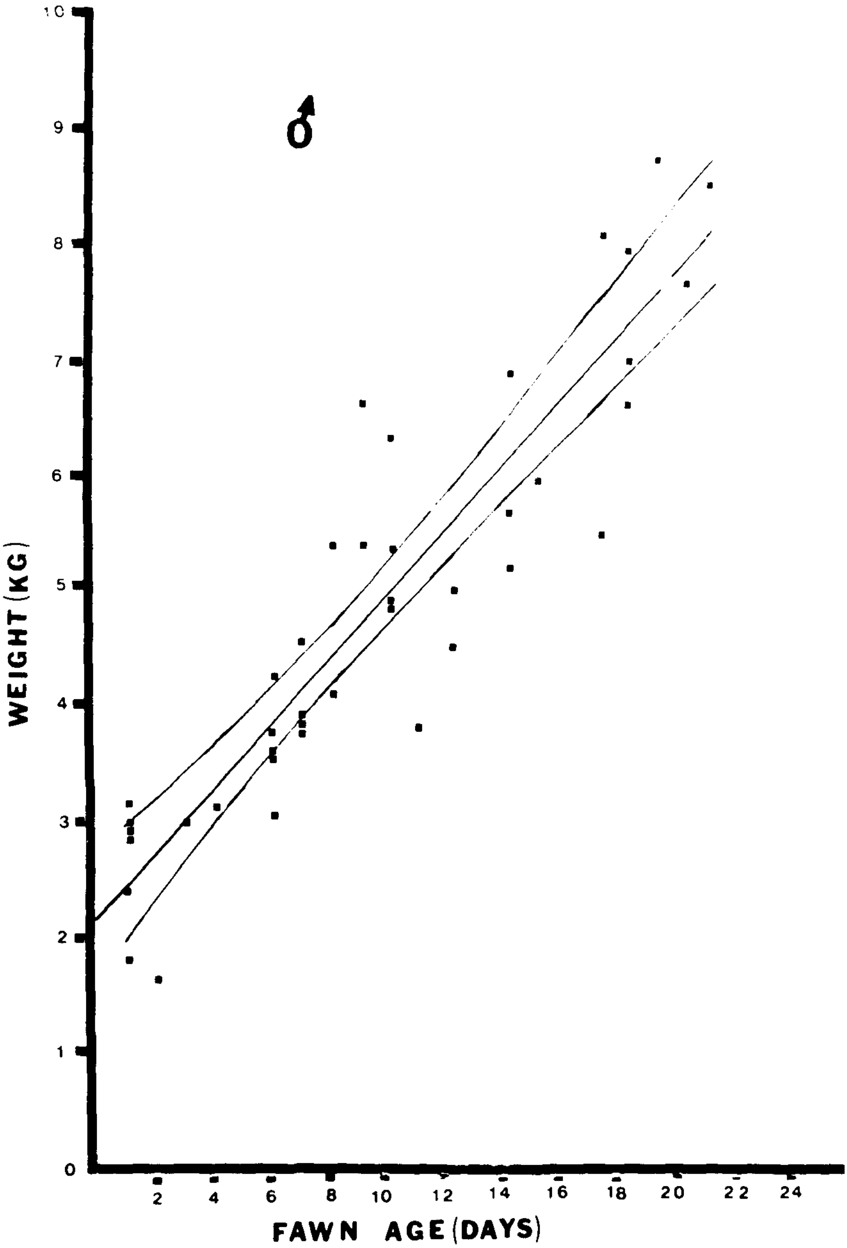

Fig. 1. Relationship of body weight to age for 41 male white-tailed deer fawns in the Wichita Mountains, Oklahoma, 1974 to 1977. The curved lines represent 0.05 confidence limits to the fitted regression line.

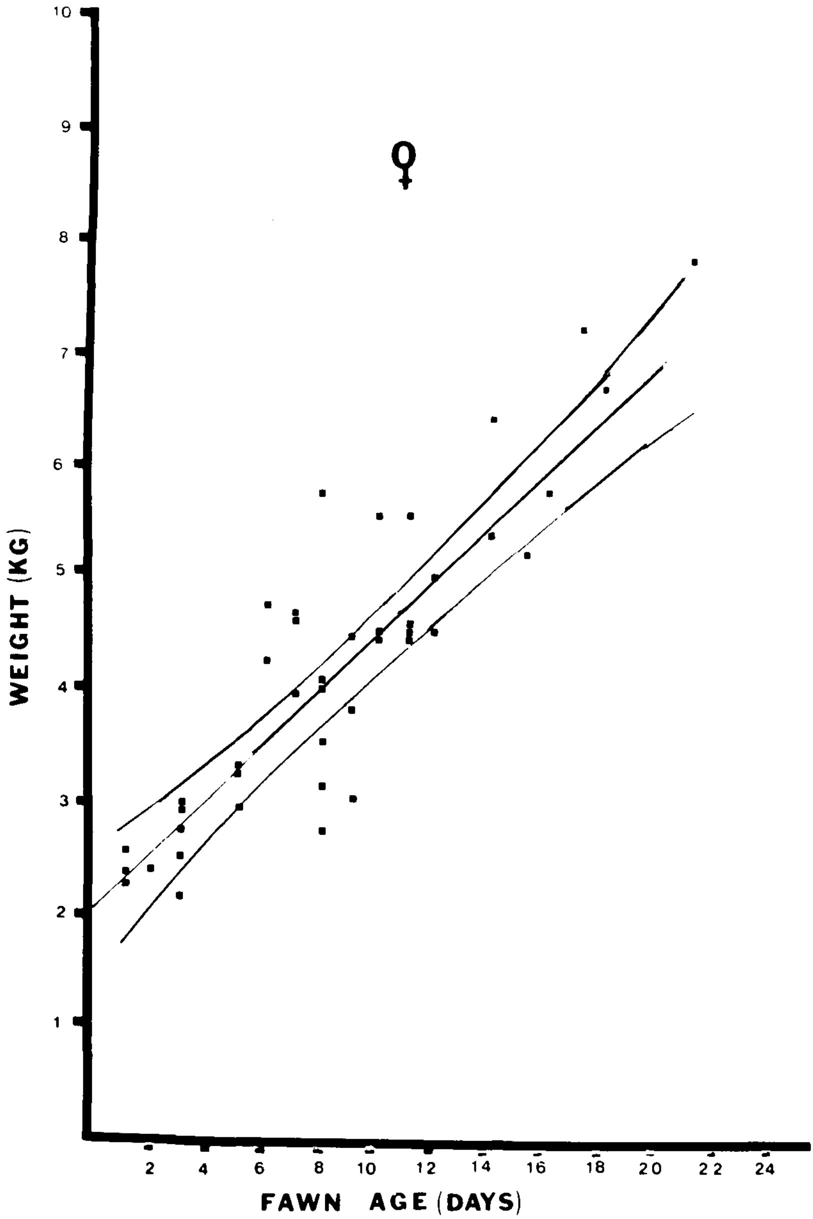

Fig. 2. Relationship of body weight to age for 42 female white-tailed deer fawns in the Wichita Mountains, Oklahoma, 1974 to 1977. The curved lines represent 0.05 confidence limits to the fitted regression line.

CONCLUSION

Fawns in the Wichita Mountains displayed a rapid growth because they belonged to the native subspecies which was naturally adapted to the habitat. Growth data obtained from wild populations can be most useful when comparing past research conducted on captive groups of fawns. However, additional information is needed to fully understand all aspects of growth in wild populations of deer. The results of investigations based on captive groups of deer are much more valuable to the resource manager when similar information can also be verified for wild populations.

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