Effects of Early Weaning on Survival and Growth of Captive White-tailed Deer[1]

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Abstract: Thirty-seven white-tailed deer fawns (*Odocoileus virginianus*) born during summer and autumn 1993 were used to study effects of early weaning on survival and growth. Fawns at birth (date recorded) were weighed (kg), measured (cm), and tagged for identification. Fawns were randomly assigned to early weaned (treatment) or control groups at 60 days of age. Treatment animals were separated from their dams at this time, and control animals remained with their dams until 6 months of age. Both groups were fed a pelleted ration containing a medium protein level (11.6%). Study animals were sedated, weighed, and measured at 6, 12, and 18 months of age. Number of points, inside width, main beam length, and main beam basal circumference of antlers was recorded at 18 months of age. Eleven animals died during the course of the study, but no deaths were treatment-related. No difference in weight or body measurements were detected between groups when animals were measured at 6, 12, or 18 months of age. No difference in number of points or antler characteristics were detected in males between groups at 18 months of age.

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White-tailed deer in the United States and Canada generally breed from October to December (Hesselton and Hesselton 1982). Fawning occurs primarily in May and June, although this breeding pattern differs throughout the Southeast. Late winter breeding has been recorded in areas of Louisiana (Roberson and Dennett 1966), Mississippi (Jacobson et al. 1979), South Carolina (Payne et al. 1966), and is the norm in Alabama (Lueth 1967, Davis 1979, Hosey 1980, Ivey 1980, Causey 1990).

Reproductive data collected by Lueth (1967) during the early and mid-1960s indicated that deer in Alabama bred from late December to early March. The majority

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of deer collected on the Stimpson Sanctuary in Clarke County, Alabama, bred in late January and early February. Average conception date for does collected in 1961, 1962, and 1964 was 16, 3, and 19 February, respectively. The overall average conception date was 11 February (Lueth 1967). Causey (unpubl. data) reported an average conception date of 10 February for does sampled from Coffee and Dale counties, Alabama. Robinette (1973) reported an average conception date of 8 February for does collected in Choctaw and Sumter counties, Alabama. Observations by Ivey (1980) and Hosey (1980) on Stimpson Sanctuary supported these findings.

Late breeding results in most fawns being born from late August to early September. For example, fawning peak on the Stimpson Sanctuary ranged from 21 August to 6 September (Lueth 1967). Animals collected by Robinette (1973) and Causey (unpubl. data) reported average fawning dates of 27 August and 28 August, respectively.

While the breeding biology of white-tailed deer in Alabama is about 3 months out of synchrony with most of North America, timing of the hunting season remains traditional. Archery season in Alabama begins 15 October and allows daily harvest of antlerless deer, except spotted fawns. Deer Management Assistance Program (DMP) cooperators using firearms are allowed to begin harvesting antlerless deer, except spotted fawns, as early as 20 November. As a result, current regulations allow for thousands of fawns ranging from 30 to 90 days old to be orphaned and prematurely weaned each year.

Limited observations have been made regarding effects of premature weaning. Harmel et al. (1987) investigated early weaning of fawns at 60 and 90 days onto a pelleted ration containing 16% crude protein (CP). They detected no difference in growth and survival between prematurely weaned and control fawns when they were fed high protein feed. Demarais et al. (1988) conducted a study of early weaning in the wild. Fawns averaging 114 days of age were weaned by shooting their dams. They found no difference in physical development between weaned and control animals. Animals reportedly were inhabiting an area with "high-quality" natural food sources. Woodson et al. (1980) reported captive fawns weaned at 4–6 months of age showed little detectable difference in social behavior compared with control fawns. They noted 12% of fawns were alone before the study and 14% were alone after orphaning.

We initiated a study during summer 1993 in which 60-day-old captive white-tailed deer fawns were weaned to a pelleted ration containing medium crude protein content. We tested the hypothesis that early weaning (60 days of age) under the conditions of the study had no effect on subsequent growth and survival.

Methods

The study was conducted at the White-tailed Deer Research Facility of Auburn University using 37 fawns born in captivity. Fawns were weighed (kg) and measured at birth. Measurements (cm) taken throughout the study included neck circumference, right front shoulder height, girth circumference, and total body length. Fawns were ear-tagged for identification, and birthdates were recorded. Dam number for each fawn also was recorded.

At 60 days post-partum, fawns were captured using Rompun® (xylazine hydrochloride; 2.2 mg/kg I.M.) delivered with a capture dart. Once immobilized, fawns were weighed and measured. Recovery from immobilization was enhanced by intravenous injection of yohimbine hydrochloride (0.24 mg/kg). At this time, fawns were assigned randomly to a treatment (early weaned) or control group. Treatment animals were separated from their dams. Short (1964) reported white-tailed deer fawns are naturally weaned at approximately 3.5 to 4 months of age. We allowed control animals to remain with their dams until 6 months of age.

Dams previous to the study had been fed a pelleted ration containing approximately 25% CP from birth. They remained on this diet throughout gestation, but were switched to a medium protein diet (11.6% CP) at parturition. Throughout the study, all individuals (fawns and dams) had ad libitum access to the ration.

All study animals were sedated at 6, 12, and 18 months of age. In addition to weight and body measurements, antler measurements [number of points, antler weight (g), inside width (cm), main beam length (cm), and basal circumference (cm)] were recorded for males (Nesbitt and Wright 1981).

Mean weight and body measurements of 6, 12, and 18 month old animals were compared by sex between groups using a separate one-way analysis of covariance (PROC GLM; SAS Inst. 1988). Weight and body measurements at 60 days of age were used as covariates in the models. Antler characteristics of 18-month-old males were compared between groups using an analysis of variance (PROC. GLM; SAS Inst. 1988). Number of antler points were square-root transformed prior to analysis because data were not normally distributed.

Results

Data from 26 of the original 37 study animals were usable in the weight and body growth analyses. Four control males, 4 treatment males, 2 treatment females, and 1 control female died. All deaths were attributed to capture-related stress or injury due to confinement.

No differences ($P > 0.05$) in weight or body growth at 6, 12, and 18 months were detected for males (Table 1) or females (Table 2) between treatment and control groups. No differences ($P > 0.05$) in any antler measurement were apparent between groups at 18 months of age (Table 1). Number of points ranged from 0–7 in the control group, since 2 control males developed spikes <2.54 cm in length. Number of points ranged from 2–7 in the treatment group.

Discussion

No differences were detected in survival and growth of captive white-tailed deer fawns weaned at 60 days of age compared with those remaining with their dams for 6 months under conditions of this study. Prematurely weaned fawns showed no signs of malnutrition. Since prematurely weaned fawns grew at a rate equal to control fawns, it was likely that fawns under the conditions of this study were functional ruminants by 60 days of age, as suggested by Short (1964). The amount of CP in the

Table 1. Mean weight (kg) and body measurements (cm) of male white-tailed deer at 6, 12, and 18, and antler characteristics at 18 months of age, Auburn, Alabama, 1995.

	Treatment			Control			
Age	*N*	$\bar{x}$	SE	*N*	$\bar{x}$	SE	*P*
			6 Months				
Weight	9	34.9	1.8	10	33.5	1.9	0.60
Neck circumference	9	31.7	0.8	10	30.1	0.7	0.39
Right front shoulder length	9	73.8	1.5	10	72.4	1.6	0.89
Girth circumference	9	83.6	2.0	10	82.6	2.2	0.99
Total body length	9	119.0	2.6	10	119.0	2.6	0.15
			12 Months				
Weight	9	54.9	2.5	9	52.3	2.7	0.92
Neck circumference	9	35.0	0.9	9	33.5	1.1	0.65
Right front shoulder length	9	83.7	1.8	9	82.0	1.2	0.70
Girth circumference	9	89.1	3.3	9	85.9	2.1	0.66
Total body length	9	136.0	2.3	9	134.0	2.1	0.91
			18 Months				
Weight	5	58.2	3.1	6	55.9	3.1	0.94
Neck circumference	5	42.5	1.6	6	37.9	3.1	0.37
Right front shoulder length	5	86.7	1.7	6	84.3	1.0	0.08
Girth circumference	5	89.1	1.3	6	87.8	4.1	0.65
Total body length	5	150.0	3.4	6	147.6	3.4	0.71
Number of Points	5	5.0	1.0	6	3.8	1.2	0.50
Antler mass (g)	5	181.0	48.4	6	134.1	50.1	0.52
Inside spread	5	16.9	2.5	6	12.3	4.3	0.41
Left main beam length	5	19.7	3.5	6	14.8	5.2	0.48
Right main beam length	5	20.3	3.4	6	14.6	5.2	0.40
Left beam basal circumference	5	8.1	0.2	6	5.1	1.6	0.12
Right beam basal circumference	5	8.1	0.1	6	5.3	1.7	0.16

diet of study animals was adequate for producing animals that appeared healthy. However, males in our study produced antlers significantly ($P < 0.05$) smaller than a similar group fed a 22% CP diet (Causey unpubl. data).

Native Alabama fawns are weaned in winter, when quality and quantity of natural forage generally are lowest and many available foodstuffs only yield enough digestible dry matter to meet basal energy requirements (Short 1975). Crude protein content of available southern forage during winter generally is 7%–9% (Causey 1964, Thorsland 1967), which is lower than our study diet. Study animals received a diet that was consistent in CP and ME content and was not reflective of nutritional fluctuations that occur in natural foodstuffs. Similarly, mean total digestible nutrients (TDN) of our study ration (61.7%; dry-matter basis) was higher than that reported (28%–44%) for available fall and winter forage (Short 1975). Naturally occurring forage likely is limited during late autumn and winter, while study animals were fed ad libitum. Also, study animals likely expend minimal energy in search of food compared to wild animals. The lack of correlation of protein content, digestibility, and quality between

Table 2. Mean weight (kg) and body measurements (cm) of female white-tailed deer at 6, 12, and 18 months of age, Auburn, Alabama, 1995.

	Treatment			Control			
Age	*N*	$\bar{x}$	SE	*N*	$\bar{x}$	SE	*P*
		6 months					
Weight	9	28.8	1.1	9	29.9	1.0	0.99
Neck circumference	9	28.9	0.5	9	29.6	0.8	0.51
Right front shoulder length	9	69.1	1.3	9	71.0	1.7	0.13
Girth circumference	9	75.7	1.5	9	80.0	2.0	0.20
Total body length	9	113.8	2.2	9	114.1	1.2	0.70
		12 Months					
Weight	9	45.7	1.0	8	44.9	1.5	0.80
Neck circumference	9	31.0	0.5	8	31.7	0.3	0.18
Right front shoulder length	9	78.0	1.3	8	79.5	1.2	0.28
Girth circumference	9	81.8	0.7	8	81.5	1.4	0.63
Total body length	9	130.5	1.5	8	129.2	1.1	0.56
		18 Months					
Weight	7	47.5	1.5	8	48.2	0.4	0.39
Neck circumference	7	33.6	0.8	8	34.3	0.8	0.56
Right front shoulder length	7	82.1	1.1	8	82.6	0.9	0.63
Girth circumference	7	83.6	1.0	8	84.4	1.2	0.88
Total body length	7	136.2	2.8	8	132.7	2.0	0.35

the study ration and naturally occurring foodstuffs is reason not to extrapolate our data to wild, free-ranging deer.

An average weaning age of 60 days was used because it reflected the approximate average age of native Alabama fawns at the beginning of the archery deer hunting season. It also was used because fawns are reported to be functional ruminants by this age (Short 1964). However, using an average weaning age for analysis may not accurately reflect conditions in the wild. Some native Alabama fawns are younger than 60 days of age when prematurely weaned.

Natural weaning begins at 3.5 to 4 months of age (Short 1964). Many native Alabama fawns nurse well into January, which is 2.5 months after the onset of the Alabama hunting season. The weaning of fawns prematurely interrupts the transfer of dam's milk, which has been reported to contain 34% CP (dry-matter basis, Silver 1961). Although no negative effects of early weaning were detected in our study, we believe the transfer of milk is important in some aspect of fawn development.

Suckling by fawns during the latter stages of lactation may provide benefits other than nutritional. A limited amount of research has been conducted on dam-fawn bonding. Bonding typically lasts well past weaning, and long-term associations between a dam and her fawns may exist (Lent 1974). Woodson et al. (1980) found no effects of orphaning on the social life of yearlings raised in a 826-ha enclosure. However, they did note that orphaned siblings associated less frequently with adults. Knowledge gained through long-term bonding may increase survival rate, though evidence is lacking. Neither our study nor Harmel et al.'s (1987) study of prematurely

weaned captive white-tailed fawns measured survival related to predation. Demarais et al. (1988), who studied free-ranging animals averaging 114 days of age, reported that in good habitat, dam removal had minimal effects on physical development of surviving fawns. Hölzenbein and Marchington (1992) reported orphaned white-tailed deer males 7 to 30 months of age survived at a higher rate than a similar control group.

Management Implications

Under conditions of this study, there were no detectable effects of early weaning on subsequent survival and growth of captive fawns. However, the conditions of our study would not be found in nature and there are numerous aspects of premature weaning under natural conditions that are poorly understood. Ultimately, none of these factors may prove to be a biological issue as regards white-tailed deer management. In Alabama, it remains unlawful to harvest spotted fawns and it is not clear whether this protection is for biological or other reasons. We suspect harvesting of spotted fawns and dams of spotted fawns is socially unacceptable. Altering traditional hunting season dates to minimize the likelihood of harvest of spotted fawns during legal sporthunting activities might need to be considered for selected areas.

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