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REGIONAL ENVIRONMENTAL DIFFERENCES AND THEIR EFFECTS ON FAWN PRODUCTIVITY

by

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INTRODUCTION

Regional variation in white-tailed deer (Odocoileus virginianus) fawn productivity rates has been observed in many states. Michigan is no exception, with fawn productivity rates of 0.65 fetuses/doe in Region III and 0.07 for Region I (Friedrich and Burgoyne 1980).

Regional variation in range quality has been shown to influence productivity and onset of puberty in white-tailed deer in New York (Cheatum and Morton 1946, Cheatum and Severinghaus 1950), Wisconsin (Hale 1959), and Missouri (Porath, pers. comm.). Range quality is usually estimated by an area's deer fertility level in conjunction with indirect measures of topography, climate, vegetative cover, and soil (Cheatum and Severinghaus 1950). Direct measures of abundance and availability of digestible nutrients by season are seldom considered in this estimation.

Other factors that affect fertility, besides range quality, also have been proposed. Ransom (1967) studied 3 areas of estimated high adult doe fertility and range quality in southern Manitoba and felt that differences in fawn fertility rates were not due to utilization of the food supply, but instead were due to only a few fawns being able to develop sexually before weather conditions retarded growth and development.

Apparently, precocious puberty in fawns is not caused by only one factor, but is the result of an interaction of many factors. Changing photoperiod is one such factor that has been shown to elicit many physiological and behavioral responses such as timing of reproductive cycles, antlerogenesis and pelage changes.

This study was initiated to investigate the effects of different photoperiods on the onset of puberty in white-tailed deer fawns.

MATERIALS AND METHODS

One- to 3-week-old female fawns were obtained from Michigan's Lower Peninsula and hand-reared in indoor pens at the Rose Lake Wildlife Research Center. Sixteen fawns were raised on a controlled light regime of 16 hours of light and 8 hours of dark (16L-8D). At approximately 3 months of age (1 September 1979), all fawns were weaned and placed on an ad libitum intake of pelleted diet (Ullrey et al. 1971). Approximately 100g of corn per fawn per day, ad libitum hay, aspen browse and water also were provided.

Body weights were measured at 2 week intervals. On 15 October the fawns were paired by weight, and a member of each pair was randomly assigned to 1 of 2 photoperiod treatments. Treatment I, early short day (ESD), was maintained on a 8L-16D schedule from 16 October through 6 February 1980. Treatment II, late short day (LSD), was maintained on a 16L-8D schedule from 16 October through 5 December, then switched to 8L-16D from 6 December through 6 February.

Baseline blood samples were taken 15 October prior to any photoperiod changes. One sample per week was taken between 16 October through 5 November. During the period of 6 November through 6 February, samples were taken twice a week. Serum progesterone was quantified by radioimmunoassay procedures outlined by Convey et al. (1977).

On 6 February each fawn was euthanized and necropsied. The pineal, thyroid, thymus, pituitary, adrenal, kidney, ovaries, and uterus were removed and weighed. The ovaries were sectioned and inspected for follicular and corpora lutea development.

RESULTS

Pelage Change

In response to the extended summer photoperiod, pelage change was delayed. Coat molt, in both the ESD and LSD treatments, was completed within 3 to 5 weeks after the winter light regime (8L-16D) was initiated.

Weight

Differences in growth rates and body weights (Fig. 1) were recorded for the ESD and LSD treatments within 2 weeks after the decreased light (8L-16D) regime was initiated. During the period of 8 August - 15 October, when both light regimes were 16L-8D, weights of the paired fawns were not statistically different. During the period 16 October - 5 December, when the ESD group was on a 8L-16D regime, ESD weights were heavier. LSD weights were heavier during the period 6 December - 6 February when they were switched to the 8L-16D photoperiods.

Examination of blood progesterone levels, and ovarian and uteral development indicated that 7 of 8 fawns in the ESD treatment had undergone estrus in late January-early February, while none of the 8 in the LSD treatment had sexually matured.

DISCUSSION

Similar growth patterns were recorded for both treatment groups following the change to 8L-16D. An increased growth rate occurred within two weeks after the short day was initiated. While the term <u>growth</u> will be used in this discussion, it has not been established whether the body weight changes represented skeleton, muscle, and organ growth or whether body fat was being deposited. The accelerated growth period for the ESD fawns was approximately

60 days, followed by a 45 day declining growth rate phase and ending with a weight loss. Mean ovulation in the ESD group occurred during the transition period from declining growth to weight loss. The 110-day cycle of accelerated growth, decline, and ovulation may have been interrupted for the LSD treatment due to the time lag between photoperiod change and the study's termination. Similar growth patterns after the photoperiod change and follicular development suggest that the LSD group would also have undergone the final growth rate decline and ovulation.

Assuming a similar response to photoperiod stimulus under natural lighting conditions, a hypothetical model of time related events can be projected. Using 15 December as the mean fawn breeding date in Michigan (Purol, unpublished data) and applying the 110-day preparation cycle produces an initiation date of 30 August. The months of September and October then become the accelerated growth phase (reproductive and winter preparation), and November and December become the phase characterized by decreasing growth rates, estrus initiation and entry into the winter weight loss period. Environmental factors that may influence fawn breeding can now be compared between Regions I and III for these critical periods.

Since only a 10-minute daylight difference exists between the 2 regions on 30 August, simultaneous initiation of the accelerated growth phase will be assumed. September and October are then the crucial months in terms of nutrient availability and capacity to prepare fawns for the onset of estrus and winter stress.

Achievement of a critical body weight by the breeding season has been implicated as the determining factor in a fawn's maturation (Abler et al. 1976). The absence of fawn breeding in a supplementally fed captive white-tailed deer herd in Region I (L.J. Verme, pers. commun.) weakens the theory of inadequate nutrition being the predominant antecedent of fawn breeding.

The occurrence of 0.04 corpora luteal scars per fawn in Region I (L. D. Fay, unpubl. data) indicates that Upper Peninsula fawns seldom ovulate. The depressed activity of hormonal mechanisms responsible for puberty may be attributed to regional environmental differences. During the months of November and December, rainfall is similar in the 2 regions while the onset of freezing temperatures and snowfall are advanced in Region I (Table 1). Light duration during late November and December levels-off below 9 hours in Region I, while Region III remains above 9 hours.

CONCLUSIONS

The synergistic effects of photoperiod, temperature, and snowfall acting on the neurohormonal regulatory mechanisms of puberty may be responsible for supressing the final stages of puberty and ovulation in Region I fawns. If this is the case, habitat management activities directed at increasing the fawn productivity rates may be overriden by uncontrollable environmental factors. Further studies are necessary to define the hormonal regulation of puberty and the factors affecting them.

The occurrence of a patterned growth response to the shortened (8-hour) day highlights the importance of seasonal photoperiod cues and corresponding nutritional requirements. A study is currently being conducted to investigate whether fat deposition, and/or body skeletal/organ growth is responsible for the accelerated growth phase noted in this study. In either circumstance, it appears that an endocrine mediated metabolic change may occur in the fall months, with a corresponding change in feed requirements. The importance of fall foods may have been de-emphasized in our research and habitat management.

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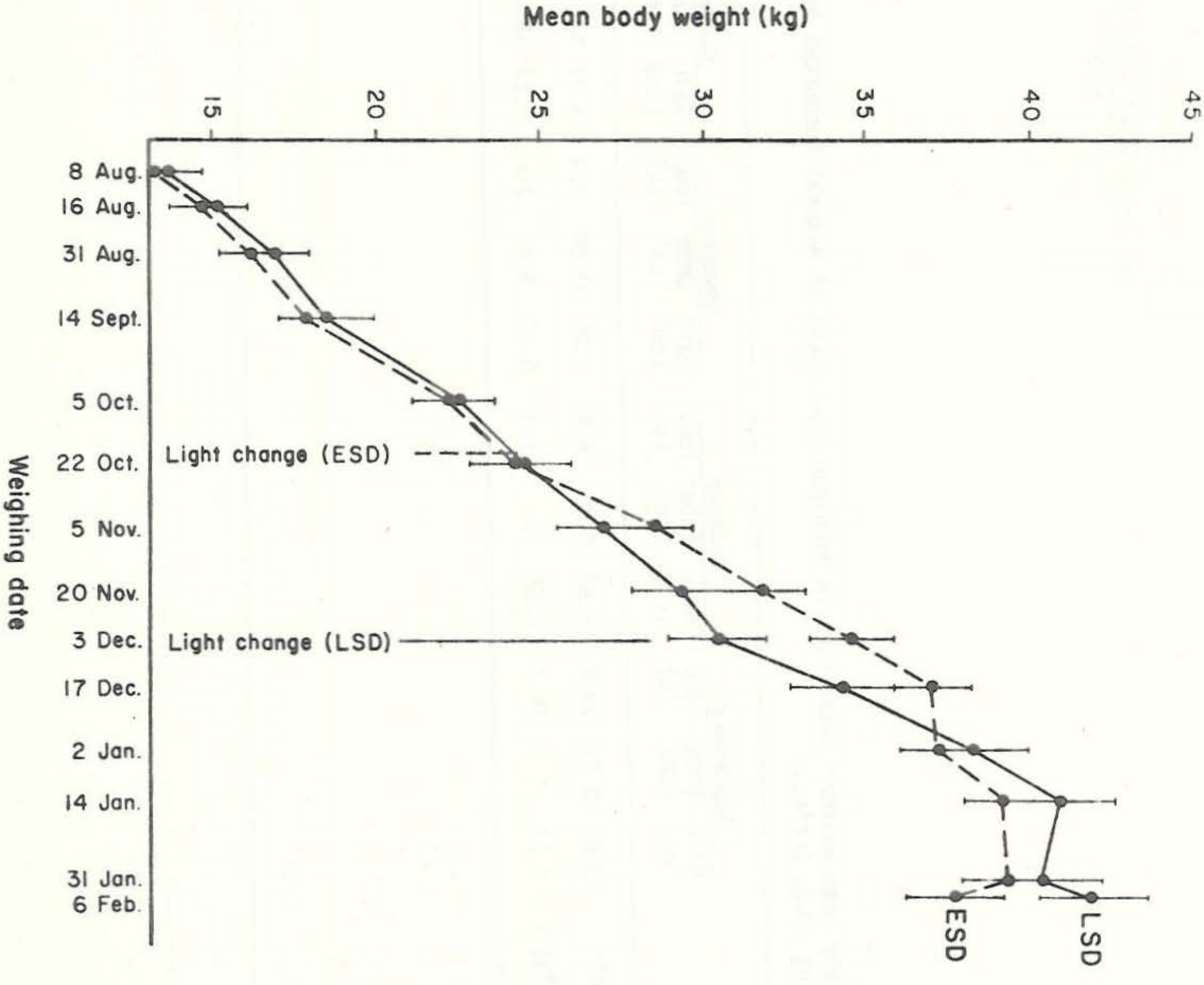
Table 1. Monthly mean weather conditions in Michigan Department of Natural Resources Regions during study period.

	September			October			November			December		
	Rain (cm)	Snow (cm)	Temp (C)	Rain (cm)	Snow (cm)	Temp (C)	Rain (cm)	Snow (cm)	Temp (C)	Rain (cm)	Snow (cm)	Temp (C)
Region I ($46^{o}34'$)	8.81	0.51	10.8	6.88	6.35	8.6	7.26	37.59	0.9	5.77	58.17	-4.9
Region III ($42^{o}05'$)	5.77	T	16.7	6.65	T	11.1	6.07	9.4	3.9	5.61	18.03	-2.6

Figure 1



Mean body weight (kg)
15
20
25
30
35
40
45
Weighing date
8 Aug.
16 Aug.
31 Aug.
14 Sept.
5 Oct.
22 Oct.
5 Nov.
20 Nov.
3 Dec.
17 Dec.
2 Jan.
14 Jan.
31 Jan.
6 Feb.
Light change (ESD)
Light change (LSD)
ESD
LSD