Selection for Antler Points and Body Weight in White-Tailed Deer

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Abstract: Body weight and antler measurements collected from pen-reared white-tailed deer (*Odocoileus virginianus*) on the Kerr Wildlife Management Area, Hunt, Texas, indicated that yearling bucks with <6 antler points are genetically inferior for both antler development and body weight. Simple correlation coefficients for body weight and total antler points were 0.59, 0.51, and 0.48 at 1.5, 2.5, and 3.5 years, respectively ($P < 0.0001$). The regression coefficients for body weight (kg) on number of antler points at 1.5, 2.5, and 3.5 years of age for 60 deer were 2.47, 1.71, and 2.36 kg/point, respectively. Number of antler points at 2.5 and 3.5 years of age was dependent on number of antler points developed by the same deer at 1.5 and 2.5 years. These data suggest that when white-tailed deer are provided, *ad libitum,* a pelleted 16% protein ration, simply removing spike bucks does not provide sufficient selection intensity for substantial genetic improvement in herd antler quality and body weight. Six antler points seems to be a good criterion for identifying inferior/superior bucks through the first 3 breeding seasons.

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Although German scientists designed genetic experiments to produce large-antlered red deer (*Cervus elaphus*) with small body size (Gottschalk 1972), the role of genetics in body weight and antler development has not been established in the white-tailed deer. Manipulation of habitat, population density, and sex ratio has been evaluated in wildlife management programs but historically genetic experiments have been omitted. This lack of genetic research may be due to an assumed low heritability or to a reluctance to devote the years of research necessary for genetic studies.

Williams et al. (1983) reported that body weight and total antler points were correlated within age classes and that yearling bucks with <6 antler points were genetically inferior for antler development and would produce inferior antlers for the second and third sets of antlers. Templeton et al. (1983)

reported "the inheritance of a single gene having a major effect on the number of antler points at 2.5 years of age" and the mode of inheritance was "simple Mendelian with a dominant allele having a major effect on phenotypic expression of from 6 to 10 antler points and a simple Mendelian recessive allele determining the phenotypic expression of from 2 to 5 antler points." Body weight and antler development are correlated only when adequate nutrition is provided. Otherwise, body growth and maintenance take precedence over antler development (French et al. 1955, 1956; Magruder et al. 1957).

In 1974, an experiment was initiated on the Kerr Wildlife Management Area (WKMA) at Hunt, Texas, to determine the effect of genetics on antler quality and body size in white-tailed deer (Harmel 1983). The purpose of this paper is to report 1 aspect of that study: to compare the relationship between body weight and number of antler points for white-tailed deer at 1.5, 2.5, and 3.5 years of age and to make genetic inferences from the comparisons.

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Methods

Six to 8 single male breeding pens were used each year. Five to 7 does were placed with each buck. All deer were individually marked, using color-coded plastic ear tags (Harmel 1983). All fawns were individually ear-tagged and tattooed at birth, and a card file pedigree record was maintained. A pelleted ration similar to the one designed by Verme and Ullrey (1972) was provided *ad libitum.* This ration contained 16% protein and recommended levels of calcium, energy, phosphorous, trace minerals, and vitamins. All male fawns were weaned at 6 to 8 months of age, placed in a 1.6-ha enclosure, and fed *ad libitum* for the remainder of the study. During the last week of October and the first week of November of each year, the male deer were weighed and their antlers removed 1 to 2 cm above the base. Antler measurements taken at this time included: number of points over 25 mm in length, maximum inside spread of main beam (cm), basal circumference (cm), main beam length (cm), and total antler weight (gm). Only body weight and number of antler points are addressed in this paper.

Statistical analyses were performed with the aid of the Statistical Analysis System (SAS) (Barr et al. 1982).

Results

Body weights and antler measurements were available for 110 deer at both 1.5 and 2.5 years of age (Table 1). Of the 34 deer that had ≥6 points at

Table 1. Distribution of 110 male white-tailed deer classified by total antler points at 1.5 and 2.5 years of age, Kerr Wildlife Management Area, 1974–1982.

Total points at 2.5 years	<6 points at 1.5 years	≥6 points at 1.5 years	Total deer
<6	26	1	27
≥6	50	33	83
Total[a]	76	34	110

[a] $\chi^2 = 12.4$, $P < 0.005$.

1.5 years of age, only 1 (2.9%) had <6 points at 2.5 years of age. Of the 76 that had <6 points at 1.5 years, 26 (34.2%) had <6 points at 2.5 years. The number of points at 2.5 years of age was not independent of number of points at 1.5 years of age ($x^2 = 12.4, P < 0.005$ [Gill 1978]).

Body weights and antler measurements were available for 81 deer at 1.5, 2.5, and 3.5 years of age (Tables 2, 3). Fifty-seven had <6 points and 24 had ≥6 points at 1.5 years (Table 2). Of these 57, 12 (21.1%) had <6 points at 3.5 years, while none (0.0%) of the 24 had <6 points at 3.5 years. The number of antler points at 3.5 years was not independent of number of antler points at 1.5 years ($x^2 = 5.9, P < 0.05$) (Table 2).

Sixty-three had ≥6 points and 18 had <6 points at 2.5 years (Table 3). Eleven of the 18 (61.1%) were <6 points at 3.5 years and 1 (1.6%) of the 63 had <6 points at 3.5 years ($x^2 = 39.3, P < 0.005$).

There were 44 deer with 2 antler points at 1.5 years and 24 of these (54.5%) had ≥6 points at 2.5 years. Thus, the probability of a buck having ≥6 points at 2.5 years is only 0.545 if the buck had 2 antler points at 1.5 years. Conversely, the probability of having ≥6 antler points at 2.5 years is 0.971 if the buck had ≥6 points at 1.5 years (Table 1).

There were 60 male deer from 8 different sires and 31 different dams for which body weight and number of antler points were available at 1.5, 2.5, and

Table 2. Distribution of 81 male white-tailed deer classified by total antler points at 1.5 and 3.5 years of age, Kerr Wildlife Management Area, 1974–1982.

Total points at 3.5 years	<6 points at 1.5 years	≥6 points at 1.5 years	Total deer
<6	12	0	12
≥6	45	24	69
Total[a]	57	24	81

[a] $\chi^2 = 5.9$, $P < 0.05$.

Table 3. Distribution of 81 male white-tailed deer classified by total antler points at 2.5 and 3.5 years of age. Kerr Wildlife Management Area, 1974–1982.

Total points at 3.5 years	<6 points at 2.5 years	≥6 points at 2.5 years	Total deer
≤6	11	1	12
≥6	7	62	69
Total[a]	18	63	81

[a] $\chi^2 = 39.3$, $P < 0.005$.

3.5 years of age. These deer tended to become heavier with age (Table 4), which is consistent with other reports (Smith et al. 1983). However, data from this study also indicated a significant linear relationship between number of antler points and body weight within an age class (Table 4). Simple correlation coefficients for body weight and antler points were 0.59, 0.51, and 0.48 at 1.5, 2.5, and 3.5 years, respectively ($P < 0.0001$). The regression of body weight (kg) on number of antler points was significantly different from 0.0 ($P < 0.01$) for 1.5-, 2.5-, and 3.5-year-old deer. The regression coefficients at 1.5, 2.5, and 3.5 years of age were 2.47, 1.71, and 2.36 kg/point, respectively. The average body weight for 1.5-year-old male deer with ≥8 points was greater than the average for 2.5-year-old deer with ≤5 points or 3.5-year-old deer with ≤4 points (Table 4). These 60 deer were also classified as <6 points and ≥6 points within each age class.

Analysis of variance was used to test the difference between average body weight for the 2 groups classified as either ≥6 antler points or <6 points. All

Table 4. Average body weight (kg) versus total antler points for 60 male white-tailed deer at 1.5, 2.5, and 3.5 years of age.

Total points	1.5 years		2.5 years		3.5 years	
	N	Weight	*N*	Weight	*N*	Weight
2	24	45.1	3	48.8	1	49.1
3	2	51.8	2	55.9	—	—
4	6	53.4	8	54.5	5	52.6
5	9	48.2	2	62.5	3	59.4
6	10	50.4	6	57.8	4	67.3
7	5	55.0	5	56.5	4	67.3
8	3	63.6	28	63.8	24	68.0
9	1	64.1	4	64.5	9	68.6
10	—	—	1	54.1	7	70.0
11	—	—	—	—	2	76.6
12	—	—	—	—	—	—
13	—	—	1	81.4	1	75.5
Total	60		60		60	

Table 5. Average body weight (kg) of 60 male white-tailed deer at 1.5, 2.5, and 3.5 years of age when classified by total antler points at 1.5 years of age.

Age	<6 points ($N = 41$)	≥6 points ($N = 19$)
1.5	47.3	54.7
2.5	58.2	65.4
3.5	64.4	71.4

body weight differences reported were significant ($P < 0.01$). The average body weight of 41 animals with <6 points at 1.5 years was 7.4 kg below the average for 19 animals with ≥6 points (Table 5). This differential was 7.2 kg at 2.5 years of age and 7.0 kg at 3.5 years of age. The average body weight at 2.5 years for 15 deer with <6 points at 2.5 years was 7.8 kg below the average for 45 deer with ≥6 points (Table 6). This differential was 6.2 kg at 1.5 years and 10.4 kg at 3.5 years of age. The average body weight at 3.5 years for 9 deer with <6 points at 3.5 years was 14.3 kg below the average for 51 deer with ≥6 points (Table 7). Again the difference was exhibited in previous years (7.7 kg at 1.5 years and 9.4 kg at 2.5 years).

Regression equations, using body weight as the dependent variable and age as the independent variable, were estimated for each group. The form of the regression equation was: $EWT = B_0 + B_1 * X$ where EWT = estimated body weight, B_0 = intercept, B_1 = regression coefficient (slope) and X = age. The equation for the group with ≥6 points was: $EWT = 43.6 + 7.4(X)$. The equation for the group with <6 points was: $EWT = 33.5 + 8.9(X)$ (RSQUARE = 0.54). The difference between the 2 slopes (1.5) was not significant; however, the difference between intercepts (10.1) was significant ($P < 0.0002$), thereby indicating greater body weights in deer with more antler points.

Table 6. Average body weight (kg) of 60 male white-tailed deer at 1.5, 2.5, and 3.5 years of age when classified by total antler points at 2.5 years of age.

Age	<6 points ($N = 15$)	≥6 points ($N = 45$)
1.5	45.0	51.2
2.5	54.6	62.4
3.5	58.8	69.2

Table 7. Average body weight (kg) of 60 male white-tailed deer at 1.5, 2.5, and 3.5 years of age when classified by total antler points at 3.5 years of age.

Age	<6 points ($N = 9$)	≥6 points ($N = 51$)
1.5	43.1	50.8
2.5	52.5	61.9
3.5	54.5	68.8

Discussion

Farmers and ranchers select the highest quality herd sires when attempting to produce quality cattle, sheep, hogs, goats, or horses. But these same individuals for generations have harvested deer with the largest body weight and antlers while protecting the "scrub" and spike-antlered bucks.

Although there is growing support for harvest removal of spikes, many landowners in Texas currently protect the spike as well as the doe. These landowners, as well as many deer hunters, embrace the erroneous idea that a spike-antlered deer is a young deer and will be a quality white-tailed deer in later years. Data collected at the Kerr Wildlife Management Area from 1974 to 1982 and reported in this paper do not support this hypothesis. These data indicate that when white-tailed deer are fed an adequate diet, a buck with <6 points is an inferior animal with respect to body weight and antler development. These data also indicate that body weight and antler points are highly correlated and, therefore, selection for or against 1 trait would automatically affect the other.

Since the regression of body weight on age is not different for the 2 groups (⩾6 points vs <6 points), and the <6 points group has a significantly lower body weight than the ⩾6 points group at all ages, it can be concluded that both groups increase in body weight at approximately the same ratio. However, the <6 points group has a body weight that is 7.4 kg below the ⩾6 points group at 1.5 years of age and remains approximately 7 kg below until 3.5 years of age. These data further indicate that individuals that have above-average body weights at 1.5 or 2.5 years of age will also be above average at 2.5 and 3.5 years, respectively. Conversely, animals that are below average at 2.5 and 3.5 years will also be below average at 1.5 and 2.5 years, respectively. Deer classified as having ⩾6 antler points at any age have a greater probability of having 6 or more points at a later age than their counterparts which were classified as having <6 points.

Total antler points at 2.5 and 3.5 years are not independent of total points at 1.5 and 2.5 years, respectively. Ten of the 60 deer observed from

1.5 to 3.5 years had ≥10 points at 3.5 years; and only 1 of the 10 had <6 points at 1.5 years. This individual had 5 points at 1.5 years and 9 points at 2.5 years of age.

Heritability estimates for body weight and antler points are not presently available. However, the chi-square tests of independence and the significant linear correlations between these traits suggest that body weight and antler points are not independent random events. Since nutrition and management were held constant, it is concluded that genotype plays an important role in the phenotypic expression of body weight and antler points.

Lerner (1950) defines selection intensity as the difference between the mean for the selected population and the mean for the unselected or original population. He further states that "the annual genetic gains are determined by the intensity of selection, the accuracy of selection, and the interval between generations." The more severely a population is culled, the greater the selection intensity and the greater the expected genetic gain (Lerner 1950); and since there is more genetic variation in the original or non-selected herd than in subsequent or selected generations, a greater selection intensity is possible and more genetic gain can be realized in the first few years of a management program.

These data suggest that the selection intensity associated with culling only spike-antlered bucks will produce minimal genetic improvement for antler development and that deer with <6 points should be removed from the breeding herd. Culling all deer with <6 points may not be applicable to all deer herds under native range conditions. This would be especially true during periods of drought, poor range conditions, and overpopulation, since even genetically superior deer may not be capable of producing 6 points under such conditions. However, since herd reduction is necessary during these periods, considerable genetic improvement could be made at this time by a management program which identifies and eliminates the inferior animals, both male and female. Some sliding scale of selection may be necessary so that in years of poor range conditions and overpopulation, a less severe culling criterion is used. In years of good range conditions, especially after a few years of good management and proper herd size, a more severe culling program may be initiated.

Hunting regulations, combined with the deer hunter's desire to collect a "trophy buck," have emphasized harvesting quality animals, thereby preserving an inferior portion of the breeding herd (Smith et al. 1976). However, by hunter education and careful culling, considerable improvement in the quality of the white-tailed deer population is possible. An increased demand for opportunities to hunt white-tailed deer has prompted reassessment of management practices. If deer populations are to be improved significantly over a reasonable period of time, effective genetic selection must become a part of all management programs along with such items as herd size, age structure, nutrition, plane, and range conditions.

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