Antler Development of Captive Louisiana White-tailed Bucks

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Abstract: We examined antler mass and number of antler points of 73 captive white-tailed (*Odocoileus virginianus*) bucks (born in 1985–89) during 1986–91 for relationships with buck maturity, birth date, and body mass, and compared development of spike- versus branched-antlered yearlings to provide harvest recommendations. Antler mass of individual bucks at each age-class was positively associated with antler mass at the subsequent age-class ($r_s \geq 0.59$, $P < 0.01$). Number of antler points of individual bucks at successive age-classes was positively associated through the 4.5-year age-class ($r_s \geq 0.41$, $P < 0.01$). Bucks with fewer antler points as yearlings had fewer antler points at the 2.5-year age-class ($r_s = 0.41$, $P < 0.01$) but added more antler points between the first and second antler sets ($P < 0.01$, $R^2 = 0.78$) than bucks with more antler points as yearlings. Body mass was associated with antler mass and number of antler points at the yearling age-class and with antler mass at the 2.5-year age-class. Spike-antlered yearlings continued to exhibit inferior antler development at the 2.5- and 3.5-year age-classes compared with branched-antlered yearlings.

Proc. Annu. Conf. Southeast. Assoc. Fish and Wildl. Agencies 46:67–74

Antler development in male white-tailed deer is a function of age, nutrition, genetics, and general health (Harmel 1982, Ullrey 1982, Goss 1983, Mattfeld 1984, Newsom 1984, Sauer 1984, Verme and Ullrey 1984, Scribner et al. 1989). Although antler characteristics have been reported related to age and nutrition (French et al. 1956, Cowan and Long 1962, Ullrey 1982, Scribner et al. 1989), other than studies on Texas white-tailed deer by Harmel (Harmel 1977, 1978, 1980; Harmel et al. 1988) we could find no reports of antler development of a large number of individual bucks from 1.5-year-old (yearling) through adult age-classes. Such information would be useful to wildlife managers in formulating harvest strategies if antler characteristics at younger ages were demonstrated to be indicative of antler development potential at older ages. Variables such as birth date also might influence subsequent antler development. Schultz and Johnson (1992) found the chronology of antler development of captive Louisiana white-tailed bucks was related to birth date.

The purpose of our study was to describe antler mass and number of antler points of Louisiana bucks at various age-classes and to determine relationships of these variables with buck maturity. Additionally, we sought to examine relationships of birth date and body mass with antler characteristics and to compare development of spike-antlered versus branched-antlered yearling bucks.

This project was funded by the Louisiana Agricultural Experiment Station under projects LAB02516 and LAB02875 and McIntire-Stennis project LAB02154. Safari Club International, Dow Chemical Company, and J. S. McIlheney provided additional support. We thank G. V. Berger for use of his property and for assistance. W. Forbes, A. Hindrichs, S. Steigler, T. Keegan, K. Dancak, B. Barry, S. Adams, B. Fritz, S. Stewart, A. Kidd, B. Brandle, G. Glass, M. Gates, G. Forbes, J. Banta, V. Hebert, and N. Bradley provided assistance in animal husbandry, sedation, and handling. Approved for publication by the director, Louisiana Agricultural Experiment Station as Manuscript No. 92-22-6188.

Methods

Captive deer were located on Ben Hur Biological Research Area, East Baton Rouge Parish, Louisiana, from study initiation (spring 1985) through December 1990. Deer were moved to new facilities on Idlewild Research Station and Shades Plantation, East Feliciana Parish, Louisiana, in January and February 1990 and remained there through October 1991.

Bucks (N = 73) born to captive does in 1985–89 or donated by the Louisiana Department of Wildlife and Fisheries were individually ear-tagged and bottle-fed evaporated milk until weaned (Johnson et al. 1987). We recorded body mass of 39 bucks at birth. Weaned fawns were placed in 0.4- to 0.6-ha paddocks and supplied fresh water and pelleted feed (Johnson et al. 1985, Lynch 1986, Johnson et al. 1987, Schultz 1987, Zeno 1987, Hindrichs 1989, Schultz 1990) ad libitum.

Antlers were removed from all bucks ≥1.5-year age-class shortly after velvet shedding (20 Aug–11 Oct) during 1986–91. We immobilized bucks with Rompun® (xylazine hydrochloride; Mobay Corp., Shewanee, Kan.) and removed antlers approximately 1.2 cm above the burr using a hacksaw. We weighed 61 bucks at the yearling age-class and 34 bucks at the 2.5-year age-class to the nearest 0.45 kg during sedation. Yohimbine hydrochloride (Sigma Chemical Co., St. Louis, Mo.) was administered to reverse sedation. Antlers were individually marked, air-dried ≥14 days, and weighed to the nearest decigram. The number of antler points ≥2.5 cm long was recorded. Change and percent change in antler mass and number of antler points between successive antler sets was calculated for each buck. Bucks with 2 antler points as yearlings were considered spike-antlered bucks (N = 20) for comparisons versus yearlings with branched antlers (N = 53).

We converted dates to the Julian calendar and used Spearman's correlation coefficients (r_s) to describe associations among ranked variables. Based upon the distribution of known birth dates, we separated bucks into early- (28 May–4 Jul, $N = 32$) and late-born (22 Jul–27 Aug, $N = 18$) groups for additional evaluations of birth date effects. We used Student's *t*-tests (Triola 1983) to compare spike- versus branched-antlered yearlings and to compare birth date groups. We used analysis of variance to determine effects of birth year and age-class and orthogonal contrasts (Ray 1982) to compare classes within these independent variables. Regression analysis was used to describe relationships between antler mass and number of antler points versus subsequent increases to the next age-class.

Results

Antler Development and Maturity

Neither birth date nor any antler characteristic differed among cohorts ($P \geq 0.19$); therefore, bucks born in all years were pooled. Mean antler mass increased through the 4.5-year age-class ($P \leq 0.05$) but did not differ between 4.5- and 5.5-year age-classes ($P = 0.71$) (Table 1). Mean antler mass at yearling to 5.5-year age-classes increased 320.8%, 53.7%, 13.0%, and 3.1% between successive age-classes. Number of antler points increased through the 3.5-year age-class ($P \leq 0.06$) and was similar ($P \geq 0.63$) among 3.5-, 4.5-, and 5.5-year age-classes. The percentage of bucks with ≥8 antler points was 9.6%, 80.0%, 95.3%, and 88.9% for the 5 age-classes (1.5 to 5.5 years at 1-year intervals), respectively (Table 2).

Bucks with greater antler mass at each age-class produced greater antler mass at the subsequent age-class ($r_s = 0.59, P < 0.01, N = 64$; $r_s = 0.83, P < 0.01, N = 43$; $r_s = 0.70, P < 0.01, N = 20$; $r_s = 0.97, P < 0.01, N = 9$ between successive sets of antlers from first to fifth, respectively). Bucks with greater antler mass as yearlings continued to produce greater antler mass at the 3.5-year age-class ($r_s = 0.58, P < 0.01, N = 42$), but not at the 4.5-year ($r_s = 0.25, P = 0.29, N = 19$) or 5.5-year ($r_s = -0.28, P = 0.46, N = 9$) age-classes. Bucks with greater antler mass at the 2.5-year age-class continued to produce greater antler mass at the 4.5-year ($r_s = 0.84, P < 0.01, N = 20$) and 5.5-year ($r_s = 0.83, P < 0.01, N = 9$) age-classes. Bucks with heavier antlers as yearlings had larger increases in antler mass to second antler sets [Antler mass increase = 397.0 + 0.5 (antler mass as yearlings); $P = 0.04$]. However, little variation in antler mass increase was accounted for by yearling antler mass ($R^2 = 0.07$). There was no relationship between increase in antler mass to the next antler set versus antler mass at the 2.5-, 3.5-, or 4.5-year age-classes ($P = 0.20$, 0.93, and 0.15, respectively).

Numbers of antler points of individual bucks at successive age-classes were positively associated through the 4.5-year age-class ($r_s = 0.41, P < 0.01, N = 64$; $r_s = 0.57, P < 0.01, N = 43$; $r_s = 0.75, P < 0.01, N = 20$ between successive sets, first through fourth, respectively) but not between 4.5- and 5.5-year age-classes ($r_s = 0.25, P = 0.51, N = 9$). Yearling bucks with more antler points continued to have more antler points through the 3.5-year age-class ($r_s = 0.35, P = 0.02, N = 42$).

Table 1. Mean antler mass (g) and number of antler points ≥2.5 cm long for captive, Louisiana white-tailed bucks at 5 age-classes, 1986–91.

		Antler mass		Antler points	
Age-class	N	$\bar{x}$	SE	$\bar{x}$	SE
1.5	73	148.7 A[a]	11.0	4.5 A	0.3
2.5	65	625.7 B	27.9	8.1 B	0.1
3.5	43	961.4 C	50.1	9.0 C	0.2
4.5	20	1,086.2 D	71.8	8.9 C	0.3
5.5	9	1,119.8 D	109.9	9.2 C	0.4

[a]Means within a column followed by different letters are significantly different ($P < 0.10$); analysis of variance with orthogonal contrasts.

Bucks with fewer antler points as yearlings added more antler points between the first and second antler sets [Antler points added = 7.25 − 0.81 (yearling antler points); $P < 0.01$; $R^2 = 0.78$]. A similar relationship existed between number of antler points at the 3.5-year age-class and antler points added between the third and fourth antler sets [Antler points added = 2.75 − 0.29 (3.5-year antler points); $P = 0.05$], but the amount of variation accounted for was low ($R^2 = 0.20$). Increase in antler points to the next antler set was not related to number of antler points at either the 2.5-year ($P = 0.11$) or 4.5-year ($P = 0.12$) age-class.

Spikes Versus Branched-antlered Yearlings

Bucks that were spikes as yearlings produced less antler mass and fewer antler points at the 2.5-year age-class and less antler mass at the 3.5-year age-class than bucks with branched antlers as yearlings (Table 3). There was no difference between spike- and branched-antlered yearlings in number of antler points at the 3.5-year age-class or in antler mass or number of antler points at the 4.5-year age-class. No

Table 2. Percent of captive, Louisiana white-tailed bucks by numbers of antler points ≥2.5 cm long at 5 age-classes, 1986–91.

	Age-class				
Antler points	1.5 (N = 73)	2.5 (N = 65)	3.5 (N = 43)	4.5 (N = 20)	5.5 (N = 9)
2	27.4				
3	13.7				
4	12.3				
5	9.6		2.3		
6	16.4	9.2	2.3		
7	11.0	10.8		5.0	11.1
8	6.8	50.8	39.5	35.0	11.1
9	2.7	18.5	16.3	35.0	33.3
10		10.8	30.2	20.0	33.3
11			7.0		11.1
12			2.3	5.0	

Table 3. Birth date (SE = days), body mass (kg), antler mass (ant. mass; g), and number of antler points (ant. pts.) of spike-antlered (Spike) and branched-antlered (Branched) captive, Louisiana white-tailed bucks, 1986–91.

	Spike			Branched			
	N	$\bar{x}$	SE	N	$\bar{x}$	SE	$P > \|t\|$[a]
Birth date	8	14 Jul	11.0	42	1 Jul	4.0	0.22
Birth body mass	8	3.1	0.2	31	2.9	0.1	0.43
1.5-yr body mass	18	55.0	1.8	43	57.6	0.9	0.15
2.5-yr body mass	7	79.7	3.0	27	77.4	1.8	0.55
1.5-yr ant. mass	20	62.5	9.5	53	181.3	12.0	<0.01
2.5-yr ant. mass	16	488.0	33.5	48	672.7	33.7	<0.01
3.5-yr ant. mass	11	739.5	62.7	31	1,031.5	59.8	<0.01
4.5-yr ant. mass	6	1,048.4	137.4	13	1,066.2	85.6	0.91
5.5-yr ant. mass	1	1,501.0		8	1,072.2	112.3	
1.5-yr ant. pts.	20	2.0	0.0	53	5.4	0.2	<0.01
2.5-yr ant. pts.	16	7.5	0.3	48	8.4	0.1	<0.01
3.5-yr ant. pts.	11	8.4	0.5	31	9.1	1.2	0.12
4.5-yr ant. pts.	6	8.7	0.3	13	8.9	0.3	0.66
5.5-yr ant. pts.	1	10.0		8	9.1	0.4	

[a] $P > |t|$ of a difference between means.

comparisons could be made at the 5.5-year age-class because antler development of only 1 spike-antlered buck was recorded at that age-class. Birth date and body mass at different ages were similar between spike- and branched-antlered bucks (Table 3).

Birth Date and Body Mass Effects

Neither birth date nor birth date group (early- or late-born) was associated ($P \geq 0.30$ and $P \geq 0.22$, respectively) with any body mass or antler variable. Antler mass and body mass were positively rank correlated at the yearling ($r_s = 0.41, P < 0.01, N = 61$) and 2.5-year ($r_s = 0.32, P = 0.07, N = 34$) age-classes. Number of antler points was associated with body mass at the yearling age-class ($r_s = 0.26, P = 0.05, N = 61$) but not at the 2.5-year age-class ($P = 0.50, N = 34$). Body mass at birth was not associated with antler mass ($P \geq 0.16$) or number of antler points ($P \geq 0.52$) at any age-class. However, bucks heavier at birth were heavier at the yearling ($r_s = 0.56, P < 0.01, N = 32$) and 2.5-year ($r_s = 0.60, P = 0.02, N = 14$) age-classes, and bucks heavier as yearlings were heavier at the 2.5-year age-class ($r_s = 0.72, P < 0.01, N = 34$).

Discussion

Mean antler mass and number of antler points increased asymptotically as bucks matured. Asymptotic expression at 3.5 or 4.5 years of age is similar to the expression of 3 of 4 antler characteristics of free-ranging white-tailed deer harvested in South Carolina (Scribner et al. 1989). Putman (1988) suggested that antler development eventually declines as bucks age past their prime. We found no evidence that such a decline had begun in our deer through the 5.5-year age-class.

Mean antler mass and number of antler points of yearling bucks fell between means of captive yearlings in Michigan on diets simulating early (N = 5) and late (N = 5) green-up (Ullrey 1982). Mean antler mass and number of antler points of bucks at the 2.5-year age-class were similar to means reported by Ullrey (1982) (N = 3, 2, and 3 in diet treatments) but greater than those described by Harmel (1977) (N = 4, 4, 4, and 5 in diet treatments) for captive deer in Michigan and Texas, respectively. Bucks with fewer antler points as yearlings exhibited some degree of compensatory antler development through the second antler set by adding significantly more antler points. However, bucks with more antler points as yearlings continued to have more antler points at the 2.5-year age-class.

Bucks with the best antler development at each age-class continued to have the best antler development at the subsequent age-class. Antler development at the yearling age-class also was indicative of development at the 3.5-year age-class. These results agree with the findings of Harmel (1988). Antler development of our bucks at the 2.5-year age-class was indicative of development at the 3.5-, 4.5-, and 5.5-year age-classes.

Mean antler mass of our branched-antlered yearlings was lower, and antler mass of spike-antlered yearlings higher at the 2.5-year through the 5.5-year age-classes than reported by Harmel (1980). Mean numbers of antler points of branched-antlered yearlings were similar from the 2.5-year through 5.5-year age-classes between our bucks and those in Harmel's (1980) study, but out spike-antlered bucks produced more antler points at these age-classes than found by Harmel (1980). We found no differences between spike- versus branched-antlered yearlings in body mass at any age. Our spike-antlered bucks remained inferior to branched-antlered bucks in antler mass through the third antler set and inferior in number of antler points through the second antler set. However, Harmel (1988) reported that spiked-antlered captive bucks in Texas remained inferior in antler mass, number of antler points, and body mass through the 6.5-year age-class.

Our results agree with those of Harmel (1988) who reported significant associations between body mass versus antler mass and number of antler points at the 1.5- and 2.5-year age-classes, except that we found no association between body mass and number of antler points at the 2.5-year age-class.

Management Implications

Generally, bucks with inferior antler development at younger (1.5- and 2.5-year) age-classes remained inferior at older age-classes. Management implications for trophy buck production are obvious. Bucks with the best antler development at younger age-classes have the greatest potential to become "trophy" bucks and should be passed over during harvest. If some younger bucks are to be harvested, they should be those with the poorest antler development (possibly spikes). Just as definitions of a "trophy" buck differ among sport hunters, so will implications for harvest strategies. There will be an opportunity cost associated with each year bucks are passed over. Natural mortality and poaching losses decrease the chance that bucks passed over will survive to the next season. Sport hunters must decide if they are willing to risk not harvesting a particular buck at all versus potentially harvesting the buck when antler development is improved.

Variables other than those measured for this study will impact a buck's classification regarding overall antler development. Tine lengths, beam circumferences, antler spread, and symmetry may impact traditional antler scores. However, harvest of quality bucks at either the 3.5- or 4.5-year age-classes appears to be the best approach for producing bucks with impressive antlers based on the variables measured during our study. Hunters on properties with high loss of bucks other than from legal hunting may wish to consider harvesting bucks at the 2.5- or 3.5-year age-classes. Our results are based upon data collected from bucks on high quality diets. Caution should be used when applying our results to areas with low quality deer diets because relationships among variables could be significantly affected by diet. However, we believe that bucks that exhibit superior antler development at younger ages will probably continue to produce superior antlers at older ages if all bucks are subjected to the same diet.

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