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Using cast antler characteristics to profile quality of white-tailed deer *Odocoileus virginianus* populations

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Cast white-tailed deer *Odocoileus virginianus* antlers from the McAlester Army Ammunition Plant (McAAP) in southeastern Oklahoma were used to assess distributions of selected antler characteristics, illustrate variation in antler development in a white-tailed deer population under a quality deer management program, and determine if harvest statistics accurately reflect antler characteristics of the population. We systematically searched cultivated food plots on the McAAP during the winter of 1995 for freshly cast antlers (N = 77). Gross scores of antlers averaged 41.9 but were slightly skewed (skewness = -0.283) towards larger antlers, suggesting that a large proportion of the population is comprised of mature animals (≥3.5 years). Mean beam length, basal circumference, and number of points were significantly greater among cast antlers than among antlers of deer harvested by hunters. These data illustrate the results of a management and harvest strategy designed to produce quality white-tailed deer, and indicate that data collected from hunter harvested deer may not be representative of the population.

Key words: cast antlers, harvest bias, harvest data, Odocoileus virginianus, Oklahoma, quality deer management, white-tailed deer

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White-tailed deer *Odocoileus virginianus* are one of the most sought after big game species in North America and are intensively managed to control population density and maintain herd viability for sustained sport-hunting. Management goals are usually achieved with the aid of hunting regulations tailored for the specific climate, habitat and herd characteristics of an area (Mattfield 1984, Euler & Smith 1985, DeCalesta 1985), and have been increasingly designed to maintain a suitable proportion of mature males in the population. To achieve such a goal, management strategies are often designed to allow young bucks to attain greater ages, thereby increasing the number of deer with large antlers (McCullough 1979: 239, Weishuhn 1983: 351). Although the strategies and theoretical framework for quality deer management have been well documented (Brothers & Ray 1975, Miller & Marchinton 1995), little information is available regarding the antler characteristics of a deer population exposed to this type of management program. Data of this type would be valuable to managers by providing baseline values from which to gauge the success of management programs.

Management programs are most often evaluated by monitoring age and antler characteristics of deer harvested by hunters (Johnson 1937, Severinghaus, Maguire, Cookingham & Tanck 1950, Anderson & Medin 1969, Richie 1970). However, this approach can be plagued by hunter biases (hunters tend to select larger antlers) and severely limited by the number of deer actually harvested. Because yearlings may be underrepresented in hunter harvest data (Hayne 1984: 208), cast antlers could provide a more accurate assessment of the prevailing antler characteristics within a deer population. We examined this hypothesis by collecting cast antlers on an area managed for quality white-tailed deer in southeastern Oklahoma, USA, to obtain an unbiased profile of morphometric characteristics and size distribution of antlers in the population. These characteristics were compared to data collected from hunter harvested deer to find out whether hunter harvest data provides an accurate profile of herd demographics.

Material and methods

The study was conducted in Pittsburgh County, Oklahoma, on the 18,212 ha McAAP, where access is strictly monitored and the deer herd is managed with the objective of producing quality white-tailed deer. Unlike other similar management systems, deer movements on and off the McAAP are not restricted by fences and no restrictions apply to the size or sex of deer that hunters may harvest. Hunting on the base is limited to primitive archery (recurve and longbow) either-sex hunts, and antlerless shotgun hunts with the objective of maintaining the buck/doe ratio near 1:2 and the population density slightly below carrying capacity. A complete description of deer management at McAAP has been reported previously (Ditchkoff, Welch, Starry, Dinkines, Masters & Lochmiller 1997).

The McAAP consists of an interspersion of post oak *Quercus stellata* and blackjack oak *Q. marilandica* uplands and native prairie grass meadows composed of broomsedge bluestem *Andropogon virginicus*, little bluestem *A. scoparium*, and panicums *Panicum* spp. Midstory shrub vegetation consists of greenbriar *Smilax bona-nox*, buckbrush *Symphoricarpos orbiculatus*, poison ivy *Toxicodendron radicans*, winged elm *Ulmus alata*, sand plum *Prunus angustifolia*, sumac *Rhus* spp. and persimmon *Diospyros virginiana*. Deer also have access to approximately 200 ha of food plots (N = 45) that are planted with rye *Lolium* spp., wheat *Triticum* spp. and clover *Trifolium* spp. and are dispersed across the area.

We collected cast antlers during January-March 1995, on food plots ranging in size within 1-20 ha; only left antlers that were shed during the winter of 1994-1995 were used in the study (N = 77). We searched food plots on ≥2 occasions using systematically aligned transects that were spaced at approximately 15 m. Vegetation on food plots was relatively sparse and typically around 5 cm in height. Due to vegetative characteristics, search pattern design and multiple searches we felt that few cast antlers were missed during systematic searches. Additionally, data collected using radio-collared deer (S. Ditchkoff, unpubl. data) did not detect differential use of food plots by immature (1.5-2.5 years old) and mature (≥3.5 years old) males. As a result, we feel that the probability of small- and large-antlered deer shedding their antlers on food plots was equal. We also collected data from the left antler of all hunter harvested bucks ≥1.5 years of age during fall 1994 (N = 80) to allow comparisons with shed antler data. Because all deer harvested on McAAP must be reported, and because we (and not the hunters) measured the antlers of harvested deer, we ensured that our sample was accurate and complete.

On each antler, we measured to the nearest 0.125 inch (0.3175 cm) the length of the main beam and all tines ≥1.0 inch (2.54 cm) in length, and beam circumferences (approximately 2.5 cm above the burr and between successive pairs of tines to obtain ≤4 circumference measurements) to obtain a gross score of size (Nesbitt & Wright 1981); all measurements were later converted to cm. Gross scores were calculated as the arithmetic sum (inches) of the lengths of the main beam and all tines, and the four beam circumference measurements; each inch counts as a point in this scoring system (Nesbitt & Wright 1981). The mass of each antler was measured to the nearest 0.01 g using an electronic-digital balance. Diameter of the antler beam was calculated from basal circumference using a simple formula (diameter = basal circumference / π) that assumes antlers are round at the base. We measured beam length, basal circumference and the number of points on antlers from hunter harvested deer in the same manner used for cast antlers. Ages of harvested deer were obtained by patterns of tooth wear and eruption (Severinghaus 1949).

We tested distributions of size variables for normality using a Wilk-Shapiro test and calculated degree of skewness and kurtosis for selected variables. Skewness measures the tendency of the mean of a distribution to vary from the median; a negative value indicates that the mean is greater than the median. Kurtosis measures the peakedness or flatness of a frequency distribution, with flat distributions indicated

Table 1. Selected character measurements of cast white-tailed deer antlers from southeastern Oklahoma.

Character	N	Mean	SE	Range Minimum	Range Maximum
Beam length[a]	77	41.2	1.59	6.0	60.6
Basal diameter	77	3.3	0.06	2.1	4.2
Basal circumference (C1)[a]	77	8.9	0.30	3.5	14.0
C2	66	8.1	0.24	4.1	14.9
C3	61	7.8	0.28	2.9	14.3
C4	55	6.6	0.25	2.9	10.2
Brow tine (G1)[a]	54	7.9	0.52	2.5	19.4
G2	59	18.0	0.69	3.5	31.1
G3	52	15.0	0.79	2.5	25.4
G4	21	9.8	0.69	2.5	14.9
Mass[b]	77	328.1	24.84	8.6	900.0
Typical points[c]	77	3.4	0.16	1	5
Non-typical points	77	0.5	0.11	0	5
Total points	77	3.9	0.21	1	9
Gross score[d]	77	41.9	1.98	7.9	73.4

[a] Beam length, circumferences, and tine lengths are measured in centimetres.
[b] Mass is measured in grams.
[c] Tines used to obtain typical scores with the system described by Nesbitt & Wright (1981).
[d] Scoring is based on the system described by Nesbitt & Wright (1981) and includes all tines.

by a negative kurtosis value. We used Tukey multiple comparisons to test if the number of typical antler points was related to basal circumference, beam length, mass, gross score and the number of non-typical points (tines not erupting from the upper surface of the main beam). The relationship between total gross score and beam length for cast antlers was assessed using second-order polynomial regression. We used a Mann-Whitney test to examine differences in beam length, basal circumference and the number of points between cast antlers and those collected from hunter harvested deer (SAS Institute Inc. 1989).

Results

Shed antlers ranged in size from spikes to one individual that had nine tines, and 30% (N = 23) had ≥1

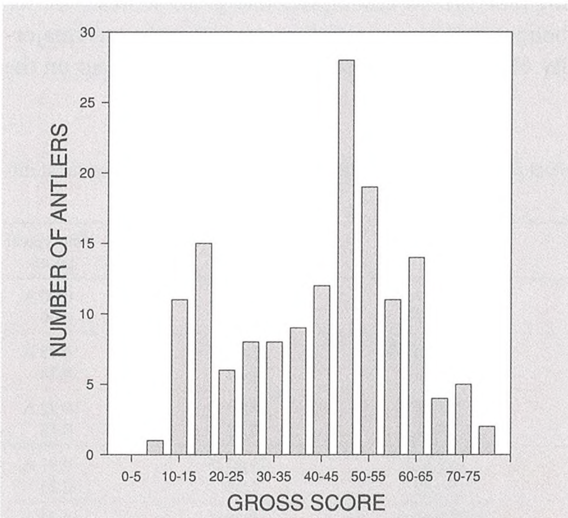

Figure 1. Distribution of gross scores from cast antlers found at the McAlester Army Ammunition Plant in southeastern Oklahoma, during January-March 1995.

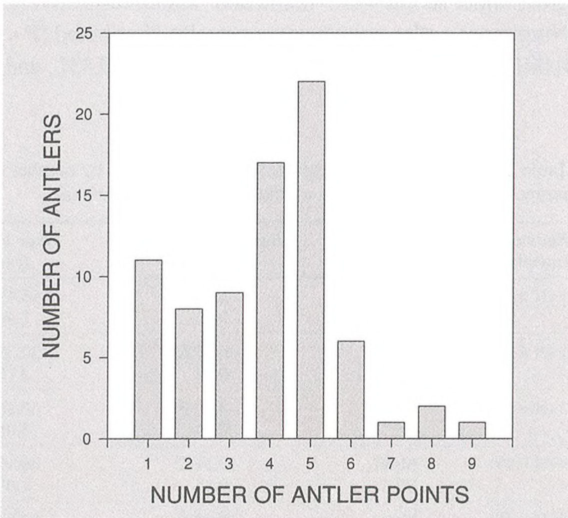

Figure 2. Number of antler points of cast antlers found at the McAlester Army Ammunition Plant in Southeastern Oklahoma, during January-March 1995.

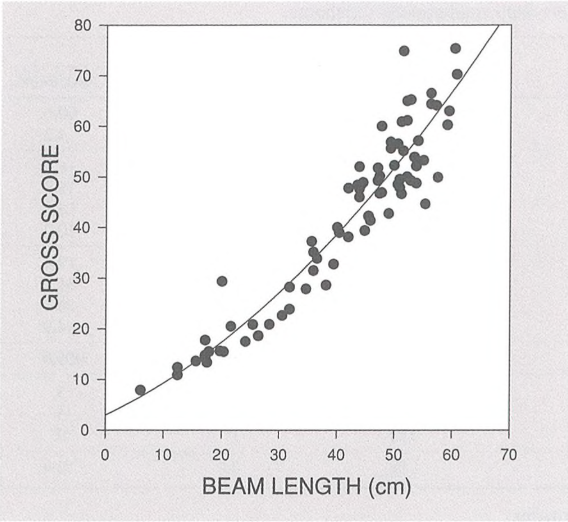

Figure 3. Polynomial regression relationship between beam length and gross score of cast antlers found at the McAlester Army Ammunition Plant during January-March 1995.

non-typical point (range: 1-5). Frequency distributions of main beam length, mass and basal circumference were normally distributed (P = 0.0001). Beam length ranged from 6.0 to 60.6 cm and averaged 41.2 cm (SE = 1.59) (Table 1). Basal circumference averaged 8.9 cm (SE = 0.30) with a maximum of 14.0 cm; basal diameter averaged 33.1 mm (SE = 0.59). Gross scores of antlers were normally distributed (P = 0.001) and averaged 41.9 points (SE = 1.98) (Fig. 1). Measures of skewness and kurtosis for the frequency distribution of gross antler scores were -0.283 and -0.888, respectively. Number of antler points were normally distributed ($P < 0.001$) and skewness and kurtosis were 0.431 and -0.375, respectively (Fig. 2). Most antlers had ≤ 5 tines (87%), with 51% possessing either four or five tines. The relationship between beam length and gross score of cast antlers was fit with the regression equation $Y = 0.009X^2 + 0.546X + 2.955$ ($r^2 = 0.89$, $P < 0.001$), where beam length was the independent variable (Fig. 3). Basal circumference, beam length, mass and gross score increased ($P < 0.05$) as the number of typical points increased, but the number of non-typical points did not (Table 2). Characteristics of antlers (total points, beam length, and basal circumference) for harvested deer (Table 3) were significantly less ($P < 0.001$) than those derived from cast antlers.

Discussion

Based upon the distribution of gross antler scores (55% of the antlers had scores >45) and the high proportion (66%) of antlers with ≥4 points, estimates of population demographics using cast antlers suggest that the McAAP deer population contains a relatively large proportion of older males. Using data collected from harvested deer, we calculated that the mean beam length of a 3.5 year-old deer was 43.2 cm, corresponding to a gross antler score of 43.3. Similarly, deer estimated to be 2.5 years old had a mean beam length of 38.4 cm and gross score of only 37.2. While it is probable that some 2.5 year-old males had gross antler scores greater than the 3.5 year-old mean (43.3), our observations suggest that these deer are not prevalent. As a result, considering that 55% of cast antlers had gross scores >45, we believe that we can safely assume that the vast majority of these deer were ≥3.5 years of age. Deer on the

Table 2. Comparison of selected antler characteristics by number of typical points[a]. Different letters in a column represent statistical difference (P ≤0.05) based upon a Tukey multiple comparison.

Number of tines (sample size)		Basal circumference (cm)	Beam length (cm)	Mass (g)	Gross score[b]	Non-typical points
1 (N = 11)	Mean	5.02 A	16.48 A	36.67 A	14.40 A	0.00 A
	SE	0.38	1.49	7.37	1.05	0.00
2 (N = 11)	Mean	6.72 AB	30.31 B	131.40 AB	25.85 B	0.45 A
	SE	0.53	2.71	25.15	2.52	0.28
3 (N = 9)	Mean	8.50 B	40.36 C	242.73 B	36.90 C	0.22 A
	SE	0.64	3.05	38.91	3.32	0.15
4 (N = 27)	Mean	10.31 C	48.19 D	412.52 C	49.25 D	0.81 A
	SE	0.35	1.06	30.29	1.67	0.25
5 (N = 19)	Mean	10.69 C	52.35 D	531.34 D	59.05 E	0.42 A
	SE	0.28	1.36	33.39	1.76	0.18

[a] Tines used to obtain typical scores following the system described by Nesbitt & Wright (1981).
[b] Gross scores are based on the system described by Nesbitt & Wright (1981) and includes all tines.

Table 3. Mean beam length, basal circumference and total number of points for left antlers of deer harvested from the McAlester Army Ammunition Plant during 1994.

		Beam length		Basal circumference		Total points	
Age	N	Mean	SE	Mean	SE	Mean	SE
1.5	49	17.4	1.17	5.1	0.18	1.7	0.11
2.5	12	38.4	1.60	7.7	0.50	3.4	0.23
3.5	6	49.2	1.99	9.9	0.55	4.7	0.21
4.5	10	50.1	4.23	10.4	0.43	5.1	0.46
5.5	0	-	-	-	-	-	-
6.5	1	46.4	-	9.2	-	5.0	-
7.5	0	-	-	-	-	-	-
8.5	2	51.3	2.38	9.7	0.16	4.0	1.00
Total	80	28.2	1.83	6.7	0.28	2.7	0.18

McAAP have the opportunity to achieve greater ages due to a hunting strategy designed to regulate hunting pressure and success through controlled access and use of primitive weapons (Ditchkoff et al. 1997). In contrast to data collected from shed antlers, harvest statistics for the McAAP during 1994 demonstrated that 24% of harvested males were ≥3.5 years old.

Mean antler characteristics of the deer herd at McAAP parallelled those reported by Roseberry & Klimstra (1975) for the unhunted Crab Orchard deer herd in Illinois. Mean beam length (40.7 cm) and antler beam diameter (28.0 mm) for the Crab Orchard herd were similar to those measured at McAAP, although the total number of antler points, assuming an equal number of points on both antlers for the McAAP herd, was somewhat greater (McAAP = 7.8, Crab Orchard = 6.2) at McAAP. Because the Crab Orchard herd had not been hunted prior to data collection, a relatively large number of mature male deer were present in the harvested portion of the population (36% were ≥3.5 years old; Roseberry & Klimstra 1975).

Deer from the George Reserve in Michigan (1960-1974) had a mean beam diameter of 21.4 mm and a mean number of points of 5.8 (McCullough 1982). These values were considerably smaller than those reported for the McAAP, although George Reserve deer were being managed under a high-yield management program designed to produce quality deer (23% of harvested, antlered bucks were ≥3.5 years old; McCullough 1979, 1982), similar to the management program employed at McAAP. Antler beam diameters of 25.9 and 27.8 mm were reported from two hunted populations of white-tailed deer in Illinois (Richie 1970). These populations had beam diameters less than the McAAP herd, which is not surprising considering the low proportion of mature deer (≥3.5 years of age) that were harvested during the study (8% and 16%, respectively).

Morphometric characteristics (beam length, basal circumference and total points) of cast antlers were significantly greater than those of hunter harvested deer, suggesting that antler data collected from hunter harvested deer may not be entirely representative of the population. It is commonly accepted that there is a hunter bias towards larger antlered deer, and it has been suggested that yearlings may be underrepresented in harvest data (Hayne 1984). However, others indicate that hunters may select for or against yearling males (Roseberry & Woolf 1988). Cast and harvest antler data from McAAP suggest that younger males may have been harvested in greater proportion than their prevalence in the population. Additional observations of radio-collared deer (S. Ditchkoff, unpubl. data) indicate that young males (1.5-2.5 years old) are more susceptible to human-induced mortality agents, such as hunting, than their mature (≥3.5 years old) counterparts. This could be due to increased susceptibility caused by inexperience, or more extensive wanderings during the breeding season. Because of this likely bias of hunter harvest data, antler characteristics obtained from representative samples of cast antlers may actually provide a more accurate representation of herd characteristics.

Shed antlers from the McAAP deer herd provided a unique opportunity to construct a profile of antler characteristics of a white-tailed deer population under quality deer management. Because cast antlers probably contain less inherent bias than harvest data, this technique should give a more accurate assessment of herd antler characteristics and provide additional information to supplement data derived from harvested deer. However, when conducting searches for cast antlers, consideration should be given to the fact that antler size affects visibility. Because our searches were conducted in areas that had exceptional visibility due to short vegetation (≤5 cm high) and because multiple searches were conducted on each food plot, we feel that few antlers were missed in our searches and our sample is representative of the population. The appropriateness of this technique may vary regionally depending upon vegetative characteristics and deer densities; search patterns specifically designed for local conditions may be required to ensure that a representative sample of cast antlers is obtained.

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References

Anderson, A.E. & Medin, D.E. 1969: Antler morphometry in a Colorado mule deer population. - Journal Wildlife Management 33: 520-533.

Brothers, A. & Ray, M.E., Jr. 1975: Producing quality whitetails. - Fiesta Publishing Co., Laredo, Texas, USA, 246 pp.

DeCalesta, D.S. 1985: Influence of regulations on deer harvest. - In: Beasom, S.L. & Roberson, S.F. (Eds.); Game harvest management. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas, USA, pp. 131-138.

Ditchkoff, S.S., Welch, E.R., Jr., Starry, W.R., Dinkines, W.C., Masters, R.E. & Lochmiller, R.L. 1997: Quality deer management at the McAlester Army Ammunition Plant: a unique approach. - Proceedings Annual Conference Southeastern Association Fish and Wildlife Agencies 51: 389-399.

Euler, D. & Smith, H. 1985: Evaluating kill quotas for deer using minimal data. - In: Beasom, S.L. & Roberson, S.F. (Eds.); Game harvest management. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas, USA, pp. 57-65.

Hayne, D.W. 1984: Population dynamics and analysis. - In: Halls, L.K. (Ed.); White-tailed deer ecology and management. Stackpole Books, Harrisburg, Pennsylvania, USA, pp. 203-210.

Johnson, F.W. 1937: Deer weights and antler measurements in relation to population density and hunting effort. - Transactions North American Wildlife Conference 2: 446-457.

Mattfield, G.F. 1984: Eastern hardwood and spruce/fir forests. - In: Halls, L.K. (Ed.); White-tailed deer ecology and management. Stackpole Books, Harrisburg, Pennsylvania, USA, pp. 305-330.

McCullough, D.R. 1979: The George Reserve deer herd: population ecology of a K-selected species. - University of Michigan Press, Ann Arbor, Michigan, USA, 271 pp.

McCullough, D.R. 1982: Antler characteristics of George Reserve white-tailed deer. - Journal Wildlife Management 46: 821-826.

Miller, K.V. & Marchinton, R.L. (Eds.) 1995: Quality whitetails: the how and why of quality deer management. - Stackpole Books, Mechanicsburg, Pennsylvania, USA, 322 pp.

Nesbitt, W.H. & Wright, P.L. (Eds.) 1981: Records of North American big game. - The Boone and Crockett Club, Alexandria, Virginia, USA, 421 pp.

Richie, W.F. 1970: Regional differences in weight and antler measurements of Illinois deer. - Transactions Illinois Academy Science 63: 189-197.

Roseberry, J.L. & Klimstra, W.D. 1975: Some morphological characteristics of the Crab Orchard deer herd. - Journal of Wildlife Management 39: 48-58.

Roseberry, J.L. & Woolf, A. 1988: Evidence for and consequences of deer harvest data biases. - Proceedings Annual Conference Southeastern Association Fish and Wildlife Agencies 42: 306-314.

SAS Institute Inc. 1989: SAS/STAT User's Guide, Version 6, Fourth edition. - SAS Institute, Cary, North Carolina, USA, 943 pp.

Severinghaus, C.W. 1949: Tooth development and wear as criteria for age in white-tailed deer. - Journal of Wildlife Management 13: 195-216.

Severinghaus, C.W., Maguire, H.F., Cookingham, R.A. & Tanck, J.E. 1950: Variations by age class in the antler beam diameters of white-tailed deer related to range conditions. - Transactions North American Wildlife Conference 15: 551-570.

Weishuhn, L.L. 1983: Management of white-tailed deer on south Texas ranges. - In: Brown, R.D. (Ed.); Antler development in Cervidae. Caesar Kleberg Wildlife Research Institute, Kingsville, Texas, USA, pp. 349-353.