BRIEF REPORTS

Zoometric Characteristics of Red Deer (*Cervus elaphus* L.) Stags from Northern Poland

PAWEŁ JANISZEWSKI* AND SZYMON KOLASA
University of Warmia and Mazury in Olsztyn, Faculty of Animal Bioengineering, Oczapowskiego 5, 10-718 Olsztyn, Poland. e-mail: janisz@uwm.edu.pl, phone/fax +48 89 5234442.

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Abstract

Carcass weight, antler weight and zoometric measurements of 98 Red deer (*Cervus elaphus* L.) stags harvested in northern Poland were analysed in the study. In order to compare their carcass parameters, the stags were divided by age into six classes. A statistical analysis of results provided the basis for describing model red deer stags representative of particular age groups.

The average carcass weight of stags in six classes was the following: stags aged two years – 67.64 kg, stags aged three to four years – 82.17 kg, stags aged five to six years – 102.40 kg, stags aged seven to eight years – 122.13 kg, stags aged nine to ten years – 143.44 kg, stags aged 11 years and older – 149.60 kg. Antler weight ranged from 0.62 kg in two-year-old stags to about 6 kg in the oldest ones. All carcass traits examined in the study were interrelated, as confirmed by highly significant coefficients of correlation (r>0.6). This suggests that they are good indicators of body conformation in red deer stags.

Key words: *Cervus elaphus*, carcass weight, measurements, antlers

Introduction

The red deer coming from various geographical regions differ considerably in body weight and measurements, antler shape, coat colour, and even in the sounds produced (Bobek *et al*. 1992, Geptner and Całkin 1947). The body weight and antler weight of the red deer increases from northwest to southeast. The deer in Hungary, Bulgaria and Serbia on average are 2 to 2.5-fold heavier than those in Scotland, and the weight of their antlers is three to fourfold higher. The biggest stags can be found in the Balkan states (Bobek *et al*. 1992). The mean body weight of 19 Polish stags in the same age group was 138.5 kg only (91 to 184 kg) (Dzięciołowski 1970). The smallest red deer live in Scotland. Their highest body weights are the following: fawns - 24 (♀) – 26 (♂) kg (after evisceration), does - 56 kg at six years of age, stags - 85 kg at seven to eight years of age (Mitchell *et al.* 1977). The red deer from Sardinia and Corsica usually weigh up to 80 kg (Dzięgielewski 1970, Bobek *et al*. 1992).

The objective of the present study was to characterize the population of Red deer (*Cervus elaphus* L.) stags inhabiting the "Lasy Taborskie" region in the Warmia and Mazury Province. Their carcass weights, antler weights and selected biometric parameters were determined in the study. A statistical analysis of results provided the basis for describing model red deer stags representative of particular age groups.

Materials and Methods

The study was performed in the Forest Division "Miłomłyn", located in the western part of the Warmia and Mazury Province, which is a part of Hunting Ground No. 4 "Lasy Taborskie ". It covers a total area of 19,173.72 ha, of which 93.1% are forests. According to Kondracki (2001), this area belongs to Central Europe, the Central European Lowland, the South-Baltic Lakeland Subprovince, and the East-Pomeranian Lakeland Macroregion. Detailed characteristics of the area are given in similar pairs, presenting the results of studies conducted in this area (Szczepański *et al.* 2003).

The research was conducted from September 1998 to February 2000 (two hunting seasons: 1998/1999 and 1999/2000). The experimental materials comprised carcasses and antlers of 98 red deer stags. The carcasses were measured immediately after shooting or at game collection points, where they were weighed. Antler weight was determined by trophy evaluation committees, and age of the stags was estimated on the basis of wear of the side teeth in the mandible.

Carcass traits and antler weight should be compared only in animals at the same or a similar age. Thus, the stags were divided into six classes:

- Class 1 – stags aged 2 years (n=14),
- Class 2 – stags aged 3 - 4 years (n=12),
- Class 3 – stags aged 5 -6 years (n=25),
- Class 4 – stags aged 7 - 8 years (n=23),
- Class 5 – stags aged 9 - 10 years (n=9),
- Class 6 – stags aged 11 years and older (n=15).

The following measurements were taken:

- **Carcass length**: from the atlas, along the backbone, to the base of the tail (±1 cm),
- **Height at withers**: from the highest point of withers to the mid-point of the base of the front leg, along the leg to the top of the hoof (with front legs perpendicular to the carcass) (±1 cm),
- **Height at sacrum**: from the highest point of the hind part of the backbone, along the hind leg to the top of the hoof (±1 cm),
- **Chest girth**: behind the withers and shoulders (±1 cm),
- **Chest width**: at the widest point, behind the shoulders (±0.5 cm),
- **Chest depth**: at the deepest point, behind the shoulders (±0.5 cm).

The numerical material was analysed with statistical programme STATISTICA 5.0 PL.

Results

Characteristics of stags in particular age classes

Tables 1 and 2 present the results of a statistical analysis of biometric parameters of stags harvested in the research area, assigned to six age classes. Mean values of all measurements obtained in particular classes differ statistically significantly (P≤0.01 or P≤0.05). The results received in the study enabled to determine age-related changes in carcass weight and measurements in the stags examined.

Table 1. Carcass weight and antler weight of red deer stags in particular age classes

Parameter	Age class	Statistical measures				
		x	S	V	x min	x max
Carcass weight (kg)	I	67.64**D d**	9.83	14.53	47	78
	II	82.17**CD d**	8.70	10.59	70	95
	III	102.40**C c**	9.63	9.40	80	128
	IV	122.13**B b**	2.22	18.18	80	191
	V	143.44**AB ab**	19.40	13.52	112	175
	VI	149.60**A a**	22.09	15.41	106	178
Antler weight (kg)	I	0.62**D d**	0.13	20.97	0.41	0.79
	II	1.39**CD d**	0.24	17.27	1.00	1.80
	III	2.21**C c**	0.54	24.43	1.40	3.53
	IV	3.31**B b**	0.85	25.68	1.60	5.50
	V	4.24**B b**	1.14	26.89	1.71	5.83
	VI	5.91**A a**	0.85	14.21	3.88	7.27

A, B, C, D – P □0.01 ; a, b, c, d – P □0.05

Table 2. Statistical characteristics of selected biometric parameters of red deer stags

Parameter	Age class	Statistical measures				
		x	S	V	x min	x max
Height at withers (cm)	I	115.86**C d**	5.76	4.97	102	124
	II	122.08**BC c**	6.49	5.32	114	134
	III	124.64**Bb c**	3.31	2.66	120	133
	IV	128.52**AB ab**	4.83	3.76	120	138
	V	132.00**A a**	4.95	3.75	125	138
	VI	131.27**A a**	4.13	3.15	125	138
Height at sacrum (cm)	I	126.00**C d**	6.06	4.81	114	135
	II	132.58**BC c**	5.98	4.51	126	145
	III	134.88**AB bc**	3.24	2.40	130	142
	IV	138.65**AB ab**	4.90	3.53	130	149
	V	141.56**A a**	4.53	3.20	135	147
	VI	140.73**A a**	4.06	2.88	133	147
Carcass length (cm)	I	133.64**D d**	11.77	8.81	110	153
	II	145.08**CD c**	8.98	6.19	130	159
	III	152.68**BC bc**	8.02	5.25	140	170
	IV	160.74**AB ab**	10.24	6.37	141	176
	V	169.00**A a**	9.45	5.59	150	183
	VI	168.27**A a**	8.07	4.80	157	185
Chest girth (cm)	I	116.00**D e**	6.93	5.97	103	127
	II	120.50**D d**	5.09	4.22	114	131
	III	126.12**C c**	3.92	3.11	117	135
	IV	132.30**B b**	5.46	4.13	119	144
	V	136.56**AB a**	5.81	4.25	127	145
	VI	138.40**A a**	4.56	3.29	129	145
Chest width (cm)	I	26.32**C d**	1.97	7.48	24	30.5
	II	28.80**BC cd**	3.16	10.97	24	34
	III	29.78**B c**	2.07	6.95	25	34
	IV	31.11**A b**	2.45	7.88	27	36
	V	32.17**A ab**	1.37	4.26	30	34
	VI	32.20**A a**	1.98	6.15	30	36
Chest depth (cm)	I	42.75**C e**	2.18	5.10	38.5	45.5
	II	45.21**C d**	1.70	3.76	42	48
	III	48.32**B c**	1.34	2.77	45.5	51
	IV	50.54**A b**	2.32	4.59	45	55
	V	52.00**A ab**	2.00	3.85	50	55
	VI	52.73**A a**	1.68	3.19	50	55

A, B, C, D – P □0.01 ; a, b, c, d – P □0.05

Biometric parameters of a model stag

Table 3 shows a statistical analysis of biometric parameters of a model stag, obtained on the basis of carcass weight and measurements and antler weight of all males examined (n=98), regardless of age. Mean, minimum and maximum values of traits, given in Table 3, determine the body conformation of a model stag harvested in the research area, at a mean age of 6.01 years.

Table 3. Statistical characteristics of selected biometric parameters of a model stag (n=98)

Parameter	Statistical measures				
	x	S	V	x min	x max
Carcass weight (kg)	110.58	31.75	28.71	47	191
Height at withers (cm)	125.67	6.93	5.51	102	138
Eight at sacrum (cm)	135.72	6.72	4.95	114	149
Carcass length (cm)	154.81	14.72	9.51	110	185
Chest girth (cm)	128.28	9.07	7.07	103	145
Chest width (cm)	30.08	2.91	9.67	24	36
Chest depth (cm)	48.68	3.79	7.79	38.5	55
Antler weight (kg)	2.89	1.79	61.94	0.41	7.27

Antler forms

Table 4 presents the percentages of various antler forms in particular age classes. Figure 1 shows the percentages of various antler forms in all stags examined, regardless of age. The forms of 7-8-point (28.6%) and 9-10-point (22.5%) antlers dominated in the population analysed.

Table 4. Trophy forms in particular age classes

Age class	Trophy form	Number (N)	%
I	pricket	1	7
	spricker	13	93
II	fork stag	2	17
	5-6 -point antlers	8	66
	7-8 -point antlers	2	17
III	5-6 -point antlers	8	32
	7-8 -point antlers	17	68
IV	fork stag	1	4
	5-6 -point antlers	2	8
	7-8 -point antlers	7	31
	9-10 -point antlers	12	53
	11-12 -point antlers	1	4
V	7-8 -point antlers	2	25
	9-10 -point antlers	5	50
	11-12 -point antlers	2	25
VI	9-10 -point antlers	5	33
	11-12 -point antlers	6	40
	13-14 -point antlers	4	27

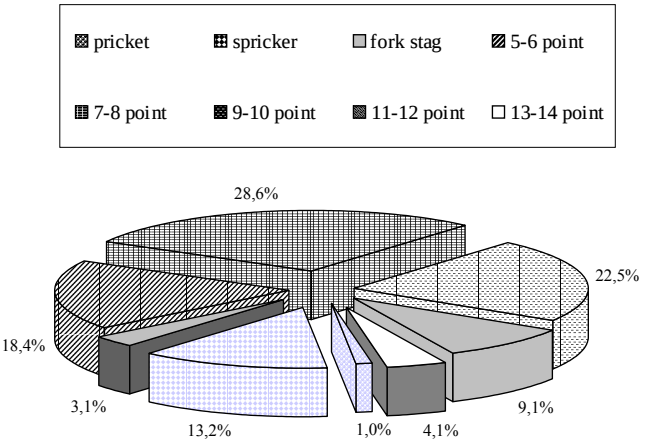

Figure 1. Percentages of various antler forms in all stags examined (n=98)

Coefficients of correlation between carcass measurements

Table 5 presents the coefficients of the correlation between carcass measurements in the whole population of stags examined in the study. The data included in this Table show that all parameters are highly significantly correlated (r>0.6). Particular attention should be paid to interdependences of the most important indices, describing the individual quality of stags, *i.e.* age, carcass weight and antler weight (r from 0.86 to 0.92).

Table 5. Coefficients of correlation between carcass measurements (n=98)

		x1	x2	x3	x4	x5	x6	x7
	Antler weight	Carcass weight	Age	Height at withers	Height at sacrum	Carcass length	Chest girth	Chest width
x1	0.862**							
x2	0.924**	0.863**						
x3	0.697**	0.830**	0.686**					
x4	0.670**	0.810**	0.664**	0.980**				
x5	0.720**	0.840**	0.750**	0.810**	0.780**			
x6	0.800**	0.900**	0.822**	0.840**	0.840**	0.820**		
x7	0.590**	0.690**	0.613**	0.670**	0.680**	0.640**	0.710**	
x8	0.800**	0.910**	0.832**	0.830**	0.820**	0.860**	0.930**	0.640**

** - P < 0.01

Discussion and conclusions

Carcass weight and measurements

In the experimental stags divided in six classes the mean carcass weight was the following: stags aged two years – 67.64 kg, stags aged three years – 82.17 kg, stags aged four to five years – 102.40 kg, stags aged six to eight years – 122.13 kg, stags aged nine to ten years – 143.44 kg, stags aged 11 years and older

– 149.60 kg (P?0.01 or P?0.05). To compare, in another population of stags in the Warmia and Mazury District the mean carcass weights were the following: class 1 (stags aged two years) – 79.26 kg, class 2 (stags aged three to five years) – 114.19 kg, class 3 (stags aged six to nine years) – 139.33 kg, class 4 (stags aged ten years and older) – 146.45 kg (Łabudzki 1993). Szczepański and Zalewski (1994), who analysed the red deer population in the former Olsztyn Province, reported that the mean carcass weight of poor-quality stags to be culled, categorized into six classes corresponding to those applied in the present study, varied from 79.7 kg in class 1 to 148.7 kg in class 6. According to Mystkowska (1966), the carcass weight of lowland stags ranged from 67 kg (one to three years of age) to 194 kg (above 12 years of age). In the Wielkopolska region the average carcass weight of stags increases to 11 years of age. In stags to be culled it reaches 122.96 kg, and in "warrantable" ones – 138.46 kg. The highest carcass weight gains, from 6.44 kg to 19.11 kg, were observed in the first four years (Łabudzki and Wlazełko 1972). Further investigations carried out in Wielkopolska confirmed that stags aged eleven years are the heaviest – 132.64 kg, which accounts for 78.18 % of weight gains in relation to two-year-old stags, and that the highest carcass weight gains, from 7.19 kg to 12.93 kg annually, are recorded in the first four years (Łabudzki 1993). As regards stags from the Bieszczady Mountains, their average carcass weight ranged from 103 kg in class 1 to 192 kg in class 4. Stags from the Sudety Mountains were much lighter – their mean body weight varied between 69 kg in class 1 to 125 kg in the oldest animals (Wlazełko 1979).

In Central and eastern Poland the mean carcass weight of stags divided into four groups was the following: stags aged two years – 85.32 kg, stags aged three to five years – 110.14 kg, stags aged six to nine years – 127.38 kg, stags aged 10 years and older – 140.99 kg (Krupka *et al*. 1986). Further research conducted in this macroregion indicated a slight increase in carcass weight, *i.e*. class 1 – 81.10 kg, class 2 – 110.63 kg, class 3 – 131.58 kg, class 4 – 146.72 kg; the body weights of these stags were increasing to 13 years of age, to reach 158.40 kg (Drozd *et al*. 2000). Kubacki and Jamrozy (1999), who used in their study the data from the region of Nowy Sącz, reported that stags older than ten years on average weighed 147.5 kg, and the mean body weight of ten strongest and fittest stags was 211.7 kg.

Changes in the carcass weights of stags from the "Lasy Taborskie" region were accompanied by changes in carcass measurements, taking the following values: carcass length – 133.64 to 168.27 cm, height at withers – 115.86 to 131.27 cm, height at sacrum – 126.0 to 140.73 cm, chest girth – 116.0 to 138.4 cm. These values were higher than those recorded for red deer stags from the Wielkopolska region, which were the following: stags aged two years: carcass length - 138.47 cm, height at withers – 119.65 cm; stags aged three to five years: carcass length – 148.49 cm, height at withers – 126.32 cm; stags aged six to nine years: carcass length - 156.29 cm, height at withers – 128.51 cm; stages aged ten years and older: carcass length – 159.8 cm, height at withers – 131.08 cm (Łabudzki 1993).

A comparison between the stags described in this study and Slovakian stags (Balis 1980) showed that the values of some carcass measurements of the latter were higher. Drechsler (1992) analysed the relationships between biometric parameters and age in the stag population from Harc, Germany. He reported that at two to five years of age the mean carcass weight of red deer stags was 83 kg, chest girth – 125.3 cm and carcass length – 188.5 cm. In stags aged six years and older these values were the following: 108 kg, 132.3 cm and 199.6 cm, respectively.

The mean carcass weight of a model stag harvested in the "Lasy Taborskie" region is 110.58 kg; and carcass measurements are: length – 154.81 cm, height at withers – 125.67 cm, height at sacrum – 135.72 cm, chest girth – 128.28 cm, chest depth – 48.68 cm, and antler weight – 2.89 kg.

The results of previous studies performed in other hunting grounds in north-eastern Poland (Janiszewski and Szczepański 2004) show that the mean carcass weight of Masurian stags is 114.5 kg. On the basis of the data collected in the Pisz Primeval Forest Żurkowski *et al.* (2000) has found that the mean body weight of red deer stags is 108 kg, regardless of their age.

It may be concluded that the carcass weights of two-year-old stags from the hunting grounds analysed in the study are generally lower, as compared with other stags harvested in the Warmia and Mazury region and other hunting grounds in Poland. At a more advanced age (eight to ten years and older) the carcass weights of Masurian stags from different hunting grounds are similar, and higher than the carcass weights of stags from the Wielkopolska region. Stags from the Bieszczady Mountains are the heaviest. The carcasses of stags examined in this study are longer than the carcasses of stags from Wielkopolska, but shorter than those of Slovakian and German stags.

Weight and form of antlers

The antler weight of stags from the "Lasy Taborskie" region, representing six age classes, is the following: class 1 – 0.62 kg, class 2 – 1.39 kg, class 3

– 2.21 kg, class 4 – 3.31 kg, class 5 – 4.24 kg and class 6 – 5.91 kg (P≤0.01). The weight of antlers increases to 12 - 13 years of age. The most intensive growth is observed for the first five years, from 29.10% to 127.42%. The maximum antler weight in the oldest males exceeds 7 kg. The dominant form of antlers is 7-8-point and 9-10-point antlers in stags aged five to eleven years. The form of 13-14-point antlers is recorded in stags older than eleven years.

The antler weight of 1800 stags from the same region of Poland ranged from 0.67 kg at two years of age to 5.91 kg at eleven years of age. In older stags antler weight decreased to 5.30 kg, and the mean antler weight in the population examined was 2.96 kg (Łabudzki 1993). According to Żurkowski *et al*. (2000), the antler weight in stags from the Pisz Primeval Forest varied from 0.7 kg (at two years of age) to 5.6 kg (at eleven years of age). Zalewski and Szczepański (2004) reported that the antler weight in stags harvested in the former Olsztyn Province ranged from 0.7 kg (at two years of age) to 5.78 kg (at 13 years of age) in stags to be culled, and from 0.95 kg (at two years of age) to 7.64 kg (at 12 years of age) in strong stags. The dominant form of antlers in seven-year-old stags and older was a regular 10-point. There were no significant differences in antler weight between red deer stags from various regions of the Warmia and Mazury Province.

In Central and eastern Poland the mean antler weight of stags ranges from 0.41 kg to 4.88 kg. In the Wielkopolska region it takes the following values: stags aged two years – 0.71 kg, stags aged three to five years – 2.02 kg, stags aged six to nine years – 3.27 kg, stags aged ten years and older – 4.85 kg (Krupka *et al.* 1986, Łabudzki 1993). On the bases of the data gathered in the region of Nowy Sącz Kubacki and Jamrozy (1999) reported that the mean antler weight of stags aged ten years and older was 5.8 kg, and the mean antler weight of ten best stags in this region was 9.79 kg. According to Drozd *et al.* (2000), the mean antler weight of stags from Central and eastern Poland varied from 0.78 kg (at two years of age) to 5.68 kg (at ten years of age) and 7.74 kg (at 13 years of age). This shows that trophy quality improved considerably over 15 years. In three hunting grounds in Slovakia the mean antler weight (from the second head) ranged from 1.81 kg to 6.7 kg in TANAP, from 1.84 kg to 7.8 kg in Polana, and from 1.46 kg to 6.60 kg in Velika Fatra (Bališ 1980). Garaj (1991), who conducted a study in Levockie Vrchy, Slovakia, reported that mean antler weight varied between 1.7 kg in three-year-old stags to 6.9 kg in 14-year-old ones.

The documentation kept at the Forest Inspectorate "Miłomłyn", that contains official statistics concerning the antlers of medal-winning stags harvested in this area during the last ten years, shows there were 28 such antlers, including six silver medal ones and 22 bronze medal ones. Thus, the hunting grounds of the "Lasy Taborskie" region may be considered an area suitable for medal deer breeding, aimed at producing high-quality antlers.

Correlations between the traits examined

Carcass measurements determined in the study turned out to be highly significantly correlated, and the value of correlation coefficient r was never lower than 0.6. The highest correlation was noted between the height at sacrum and height at withers (r = 0.98), and between the chest depth and chest girth (r= 0.93).

Highly significant coefficients of the correlation were also observed for antler weight and age of stags and carcass weight: r = 0.924 and r = 0.863 respectively. These values are consistent with those obtained by Krupka *et al.* (1986) and Drozd *et al*. (2000). In their studies, conducted in Central and eastern Poland, the coefficient of the correlation between the antler weight and carcass weight was 0.73. In the hunting grounds of the Wielkopolska region (Łabudzki 1993) the coefficients of correlation between antler weight and age of stags and carcass weight were 0.91 and 0.86, respectively. Goryńska (as cited in Łabudzki 1993) determined the coefficients of the correlation between the antler weight and age of stags in four different regions of Poland, which were 0.72, 0.63, 0.67 and 0.80 in the populations from the areas of Zielona Góra, Krosno, Olsztyn and Wrocław, respectively.

The above correlation coefficients, and especially the relationships between the most important parameters describing the individual quality of stags, *i.e.* age, carcass weight and antler weight, confirm that they are good indicators of body conformation in red deer stags from the "Lasy Taborskie" region.

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ЗООМЕТРИЧЕСКАЯ ХАРАКТЕРИСТИКА САМЦОВ БЛАГОРОДНОГО ОЛЕНЯ (*CERVUS ELAPHUS* L.) СЕВЕРНОЙ ПОЛЬШИ

П. Янишевски, Ш. Коляса

Резюме

В работе представлены результаты зоометрических измерений, с учётом веса туши и рогов самцов, проведенных на 98 самцах благородного оленя (*Cervus elaphus*), добытых на охоте на территории северной Польши. Для определения параметров туши, самцы разделены на шесть возрастных групп. Статистический анализ полученных результатов послужил обобщенной характеристики наиболее часто добываемых оленей разного возраста.

Показано, что средний вес туши самцов достигает: у 2-летков – 67,64 кг, у 3-4-летков – 82,17 кг, у 5-6-летков – 102,40 кг, у 7-8- летков 122,13 кг, у 9-10- летков – 143,44 кг и у 11-летних самцов и старше – 149,60 кг. Вес рогов колеблется в пределах от 0,62 кг у 2-летних самцов до около 6 кг у наиболее старых. Все проанализированные параметры туши взаимозависимы, что подтверждается значительной корреляцией (r>0,6). Приведенные параметры могут быть использованы для оценки самцов благородного оленя.

Ключевые слова: *Cervus elaphus*, вес туши, измерения, рога