Evaluation of European Red Deer (*Cervus elaphus hippelaphus*) antlers traits in district of Čadca

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Abstract
The paper abstract will be written with Times New Roman 10 pt., justify. It will contain maximum 200 words.
A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, references should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

Keywords: Provide a maximum of 6 keywords, with a font of TNR 10, in alphabetical order, separated by commas. These keywords will be used for indexing purposes.

1. Introduction

The red deer antlers represent one of the most impressive examples of a sexually selected weaponry trait in mammals and are regrown annually. In red deer, males use antlers during the rutting season in fights with other males in order to defend harems of females, and thus gain paternities [1]. Antlers of Cervidae family are an example of fast growing tissue and the only organs of the mammals capable of complete regeneration [2]. Antlers are a secondary sexual characteristic that develop from structures on the frontal bone called pedicles. Pedicles develop in the first year of life, around 4–8 months of age, under the influence of testosterone and, once mature, support the subsequent growth of first antlers [3]. The first antlers reach usually the shape of spiker [4]. Antler growth from the tip of the pedicles occurs quite rapidly between 6 and 12 months of age for red deer, depending on live-weight and genotype, with antler hardening occurring at puberty at 13–15 months of age [3]. Casting of the previous year's antlers and the immediate start of growth of the current year's antlers occurs during the spring [5], when testosterone levels are very low and day length is increasing [6, 4]. Rising levels of testosterone as the autumnal rut approaches act as a brake on longitudinal growth [8], leading to the velvet covering, which initially covers the antlers and is rich in vascular tissue [6], dying and then being cleaned from the antlers in late summer. Large antlers are associated with high annual breeding success [6, 10], although this association does not necessarily indicate a causal relationship [11]. Antler mass shows pronounced age-related variation [9, 12] and sensitivity to both environmental conditions and population density [9, 12-14] suggesting that it may be correlated with individual condition. The high population density [15] as like as the snow cover amount and length causes delaying of antlers growth start [16]. The increasing body size (live weight) correlated

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positively the length of the 1st antlers, so the large body size is an important criterion to develop the trophy quality of a population [17]. An expressive influence of climatic condition on stag antlers production was proved in red deer stags older five years. The mild winters caused increasing of some antlers traits (number of tines, antlers weight and main beam length) measures in following antler cycle. Genetic information influences the antlers trait as well [2]. Heritability estimates of between 0.43 and 0.85 for velvet antler weight of 2 – 8 year old farmed red deer stags in New Zealand was reported [18], and heritability estimates of 0.47–0.70 were reported by [19] for 18-month-old white-tailed deer hard first antler main beam length in the USA. Each year the antlers are discarded and each year the new set of antlers are grown. This is called a cycle of antlers growth and it is closely associated with the reproductive cycle, hormonal processes, climate and hydrological factors [2, 15]. Antler growth phenology became earlier and antler mass became greater with increasing age, until approximately 8 years old, after which point there was a marked flattening in the level of antler development [1, 14]. Some antler traits start to decline at 10 year of age [14]. The number of tines increases up to 14 years of stag´s age and the trophy quality depends on the age of stag [20]. The main beam length as a most important trophy trait increased up to 14 year of age, with the highest intensity of growth up to the 6th – 9th year of age [14]. Each antler trait of trophy quality partakes different rate on antler shape and total point score and that way influences the morphometric attributes of stag´s antlers [21]. The beam length is considered to be the most important trophy quality measure [22]. The peak of trophy quality reach the red deer stags in the age of 11–12 years [23, 24].

2. Materials and methods

Analysed territory characteristics

District of Čadca belongs to the region of Kysuce that extends on the west-northern part of Slovak republic. District presents area of 760.62 square kilometres. The forest ratio is quite high and reaches more than 57 % of the territory. The red deer presents stabile part of hunting management with normative density of 764 animals and average year harvesting 200 stags from about 660 animals hunted. It means that the population density is very high.

Animals analysed

European red deer stags (*Cervus elaphus hippelaphus*) hunted in the age from 2 to 14 years were included to analyses. Altogether 242 red deer stag antlers were analysed in the study.

Data collection

242 of thoroughly filled trophy evaluation forms for red deer antlers measuring as the official paper of CIC evaluation of the hunting trophies were used as a base for data collection. The population was divided in groups according to the age of the animals. The age was determined as the expert estimate according to tooth abrasion. The length of main beam - BM, weight of the dry antlers (after scull weight deduction)-W, number of tines–NT and total points score–CIC were analysed in the study.

Data analyses

Statgraphics Centurion programme was use for data analyses. Descriptive statistics were calculated for each group and age. F-test (ANOVA) was used to determine the significance of differences between each monitored age.

3. Results and discussion

The results of trophy quality main trait analysis are presented in table 1. The most expressive trophy traits are the beam length, weight of the antlers and number of tines. The total trophy quality is expressed by total point score count by CIC method of trophy evaluation.

Main beam length

The values of main beam length are presented in Table 1. A significant differences were detected between the average values for each age of analysed animals. The red deer as a long lived animal expresses a large variability of body habitus and trophy size.

Table 1. Average values±SD of analysed traits in relationship to the age of stags

Age[years]	BL [cm]	W[kg]	NT [pcs]	CIC points
	$\vec{x}$ ±SD	$\vec{x}$ ±SD	$\vec{x}$ ±SD	$\vec{x}$ ±SD
2	53.18±7.75^{a}	0.94±0.37^{a}	6.05±0.89^{a}	89.98±12.06^{a}
3	59.64±7.64^{b}	1.53±0.50^{b}	7.03±1.82^{b}	105.94±13.25^{b}
4	67.54±8.24^{c}	1.99±0.55^{c}	8.00±1.27^{c}	117.13±13.59^{c}
5	75.13±9.29^{d}	2.80±0.78^{d}	9.07±1.24^{d}	135.62±15.29^{d}
6	84.37±7.01^{e}	3.80±1.20^{e}	9.875±1.25^{de}	152.83±15.99^{e}
7	85.76±10.20^{e}	4.01±0.84^{e}	10.25±1.85^{ef}	156.61±13.89^{e}
8	88.26±14.36^{ef}	4.16±0.79^{ef}	10.00±1.61^{def}	160.16±16.05^{e}
9	89.91±3.96^{efg}	3.87±0.58^{e}	9.75±1.03^{def}	160.68±7.97^{e}
10	95.36±6.33^{fg}	4.36±0.63^{ef}	11.00±1.41^{efg}	165.92±7.77^{ef}
11	95.03±7.10^{g}	5.18±1.41^{f}	10.91±2.02^{f}	172.83±12.74^{f}
12	93.25±3.96^{fg}	5.01±0.95^{f}	12.00±2.51^{gh}	174.05±12.39^{f}
13	97.00^{efg}	4.50^{f}	12.00^{defgh}	174.38^{efg}
14	99.50^{efg}	7.54^{g}	15.00^{h}	210.20^{g}
P-value	0.0000	0.0000	0.0000	0.0000

Means values with different letters, in the same column, showed a statistical significance of P≤0.05

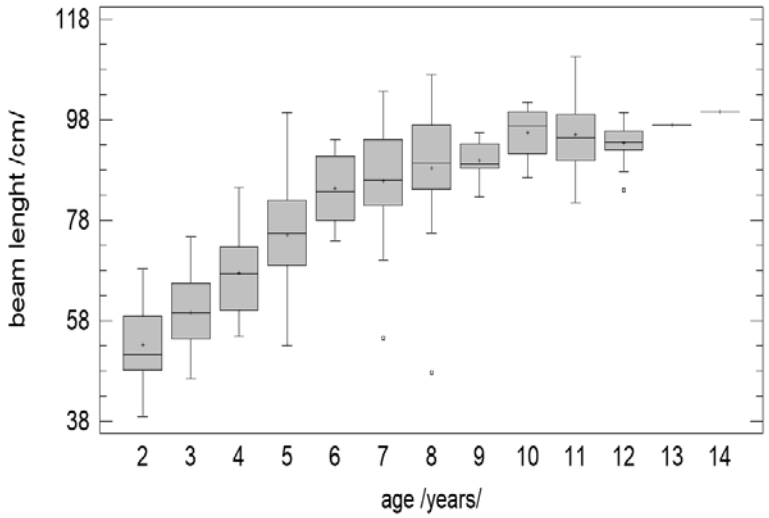

Figure 1. The dependence of main beam length on the age of the stags

The beam length monitored in different age of stags varied from 53.18 to 99.50 cm in two y. o. and 14 y. o. respectively. Large scales of values were determined due to the long lived characteristic of red deer. The longest beams were determined in the age of 14 years, so we can note that the beam length keeps it´s raising tendency during all analysed age of stags. The highest intensity of beam rising is visible until the 6th to the 9th year after which a flattening of increase is marked. Our results are in accordance with the results of [14] that presented the same findings. The deceleration of grow intensity was determined at 10 years as similar as [14] find out too.

Weight of the antlers

The weight of the antlers is related to the produced mass of the antlers [9]. The basic statistical characteristics of red deer antlers weight from district of Čadca are shown in table 1 and the dependence of antler weight on the age of stags is presented in Figure. 2. As same as previous trait, antlers weight shows high dependence of age of the stags. Significant differences were obtained

between analysed groups. The highest growth rate was determined until the 7th year after that only a slight increasing of weight occurred however the weight is rising still up to the 14th year of the age. Though the dependence of antler weight on the age of stags is proved [9, 12], we obtain the increasing of antlers weight up to the 14th year. The lowest weight was obtained in young animals 0.94 kg was the average value of 2 y. o. stags, average weights of red deer stags older 7 years shows some variability but no tendency of decreasing was determined.

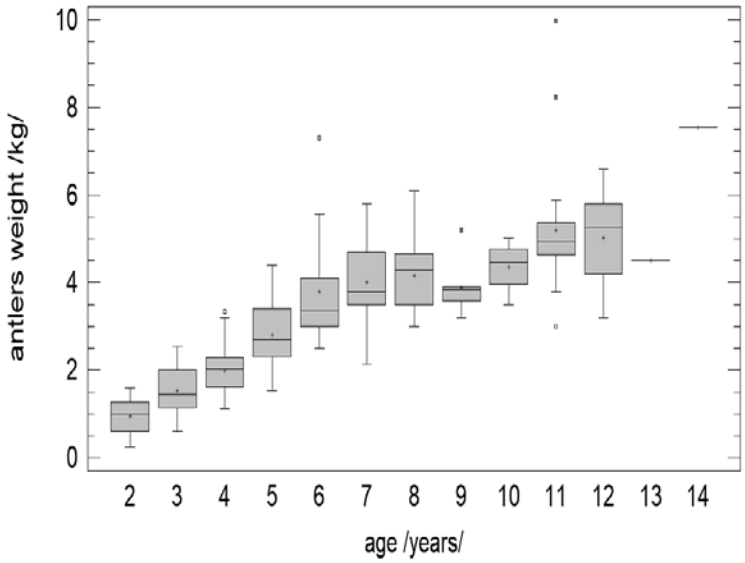

Figure 2. The dependence of antlers weight on the age of the stags

Number of tines

Analyse of tines number is shown in Table 1. As the typical antler shape of two years old stag is the six-pointer [4, 11], we obtain the same average number of tines of two years old animals of 6.05 tines. The number of tines increased according to age rapidly up to the 6th year and after that age a variability of values occurred. However from the point of view of all ages analysed, the average number of tines increased with different intensity up to the 14th year of age. Our findings are in accordance with the results of [20] that find out the same results.

The highest value of tine number (15 tines) was obtained in 14 years old stags though only one stag was detected in this age.

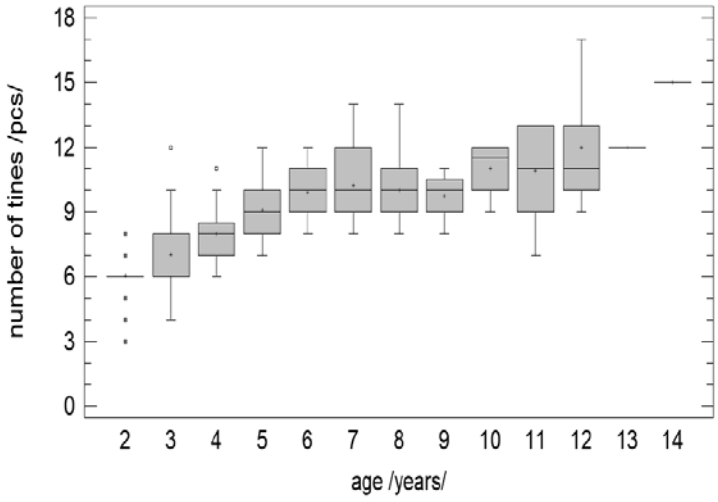

Figure 3. The dependence of tine number on the age of stags

Total points score

The total points score according to CIC trophy measuring methods is considered to be the expression of trophy quality of the population. The individual of 10 years of age is considered to be the mature stag according to CIC rules [25]. The antlers growth is shown in the Figure 4. The table as such as the Figure 4 shows close correlation of the antlers grow and the age. The lowest value of total points score was detected in 2 years old stags and the highest in 15 years old stags, 89.98 and 210.20 CIC points respectively. The highest intensity of growth was determined up to the 7th year after which a deceleration is expressed.

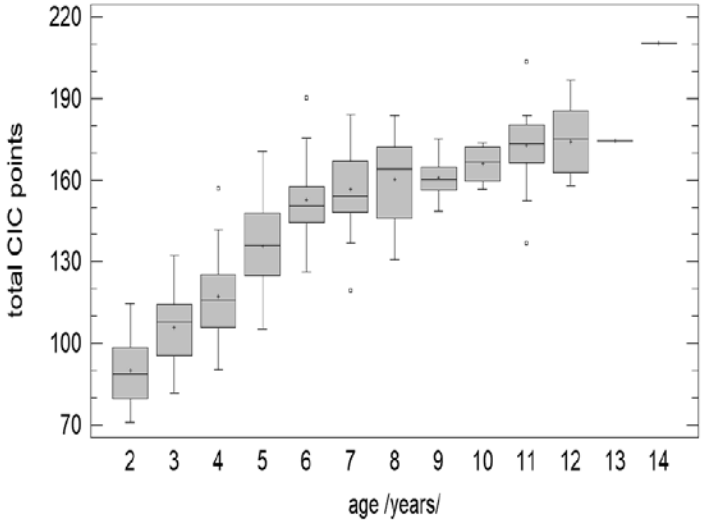

Figure 4. The dependence of total CIC points score on the age of stags

The highest intensity of antler growth was detected up to the 8th year [1, 14]. The trophy culmination is in the 11th – 12th year of stag´s age [23, 24]. The Slovak legislation [26] notes that the trophy culmination of red deer stag is in the age of 11 years and the stag of 11 years of age is able to hunt, without respect of selection criteria. Our results show that the trophy quality of red deer stags as like as each antler trait values influencing the trophy quality analysed in region of Čadca increased slightly also after the 11th year of stags age that confutes previous results. The same results were proved also in different regions of Slovakia [27, 28]. Our study as same as results of other authors [20, 27, 28] show that the culmination of red deer stag trophy can occur in later age like 11 years, nevertheless the antlers traits and trophy quality is individual trait depending on genetics and a large scale of external factors.

4. Conclusions

The most expressive red deer antlers traits were analysed in this study in dependence on age of stags. The stags aged from 2 years to 14 years were analysed. Our study proved that all the traits analysed in the experiment show increasing of average values in dependence on age also after the age of 11 year, considered as the age of trophy culmination. Increasing of analysed trait values after that age proves the longevity of red deer. As the hunting management notes that the trophy culmination of red deer is in 11th year our results as like results of other authors show that selective hunting in these ages is still reasonable to reach the peak of antlers mass and total CIC points score. In accordance to our results we suppose that management of red deer in analysed region as like as in whole country causes untimely culling of stags. The respect of longevity of that species will bring increasing of strong trophies production in the age of biological culmination.

Acknowledgements

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