Summary of Comments on Analysis of Hungarian red deer trophies by means of Principal component analysis in two different counties

A magyar gímszarvas trófea paramétereinek összefoglaló elemzése főkomponens analízissel két megyében

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Abstract

Authors analyzed data of 9 trophy parameters (weight of the antler, length of main beam, length of brow tine, length of bay tine, length of tray tine, circumference of coronet, lower circumference of main beam, upper circumference of main beam, number of total tines) of 6868 red deer stags shot between 1997 and 2007 and estimated ages were between 4-16 years, from two counties of Hungary (5946 from Somogy and 921 Bács-Kiskun). General linear model was used to evaluate age and “county” effects on the trophy parameters. Age was a significant source of variation for all studied traits while county affected most of the studied parameters. Consequently the dataset was analyzed separately for each county. Low to high correlations (adjusted for age effect) were found both in Somogy (r=-0.04 - 0.80) and for Bács-Kiskun (r=-0.06 - 0.70). Using principal component analysis (with orthogonal rotation) 4 factors were extracted which accounted for 73 % and 75 % of total variance in Bács-Kiskun and Somogy county respectively. The first factor represents the circumferences of the trophy, the second factor the main tines (brow, bay, tray) of the antler. The third and fourth factors represented the number of total tines of the trophies and the length of main beam respectively. These identified factors could be considered in selection/evaluation of the trophies in Hungarian red deer instead of the traditionally used measurements in order to maintain type and quality of the red deer trophy in Hungary.

Keywords: red deer, Hungary, antler, morphometry, selection

Összefoglalás

A szerzők két magyarországi megye területéről (Somogy megye: 5946 egyed és Bács-Kiskun megye: 921 egyed) származó lőtt gímszarvas bika (6868) 9 trófea paraméterét (az agancs tömege, szárhossz, szemág hossz, jégág hossz, középág hossz, rózsa körméret, alsó körméret, felső körméret, ágak száma) elemezték. A

bikák 1997 és 2007 között estek el, és a becsült koruk 4-16 év közötti volt. A kor és a „megye” hatását a trófea paraméterekre általános lineáris modell segítségével állapították meg. A kor minden vizsgált, míg a „megye” a legtöbb paraméterre szignifikáns hatást gyakorolt. Ezért a további elemzéseket megyénként külön-külön végezték el. Gyenge és közepesen szoros korrelációt (figyelembe véve a kor hatását) találtak a trófea paraméterek között mindkét esetben (Somogy megye: 0,04-0,8, Bács-Kiskun megye: 0,06-0,7). Főkomponens analízissel (ortogonális forgatással) 4 faktort állapítottak meg, melyek Bács-Kiskun megyében az összes variancia 73 %-át és Somogy megyében 75 %-át foglalták magukba. Az első faktor a körméreteket, a második a főágak hosszát (szemág, jégág középág) tartalmazta. A harmadik faktor a trófea ágainak számát, míg a negyedik a szár hosszát foglalta magába. A meghatározott faktorok lehetőséget nyújtanak a jelenlegi vadgazdálkodási gyakorlatban alkalmazott selejtezési szempontok objektivitásának növelésében, ezáltal segíthetik az agancsfejlesztő képességre irányuló hatékonyabb szelekciót.

Kulcsszavak: gímszarvas, Magyarország, agancs, morfológia, szelekció

Introduction

The red deer is the largest and the most important game in Hungary. The main trophy of red deer is their antler, which is re-grown every year. The red deer's first antler starts to grow between 8.5 and 14 months of age. Antlers are the male's secondary sexual characteristics and used for display and in combat. They are bony appendages of the deer's head, which are cast and regrown each year. The development of antlers is a modified endochondral ossification process (Rucklidge et al., 1997). The growth rate of the antler may reach over 100 g per day between May and July (on the northern hemisphere), enormous bone mass (generally 7-9 kg, occaisionally 13-15 kg, as reported from the Danube-Drava-Gemenc-Bilje Park of Nature in Hungary and Croatia) develops within 120-150 days (Stéger et al., 2010). At the end of the antler growing period the hard bony antler is the trophy. The deer wears this trophy during 6-8 months, then the antler is casted in spring and the new antler starts to grow (Bokor et al*.,* 2010).

The Hungarian red deer trophies are highly valued worldwide. These trophies are shot by foreign hunter guests in most cases, thus they have a considerable impact also from economical point of view.

The analysis of antler developing capacity would require too much time if we would intend to collect data annually from a single population, for this reason all data for the evaluation were collected from the National Game Management Database of Hungary.

This database was created through the continuous registration of the trophy parameters in every year from every part of the country.

For the trophy judgement several score systems are used in the world as SCI (Safari Club International, 1973) CIC (Conseil International de la Chasse/International Council for Game and Wildlife Conservation, 1954), Nadler (by Nadler Herbert, 1937) and Douglas score (by Norman Douglas, 1959) (New Zealand Deerstalkers' Association, 2012).

In Hungary the CIC and Nadler formula are used to measure and grade the trophies.

The CIC is the internationally accepted scoring system in Europe it prefers the long main beams and fewer points (tines). On the contrary the SCI (Safari Club International) score system is used in the other parts of the world (USA, New Zealand), which favours the many tines on the trophy. The evaluated parameters of the antlers are depicted in figure 1.

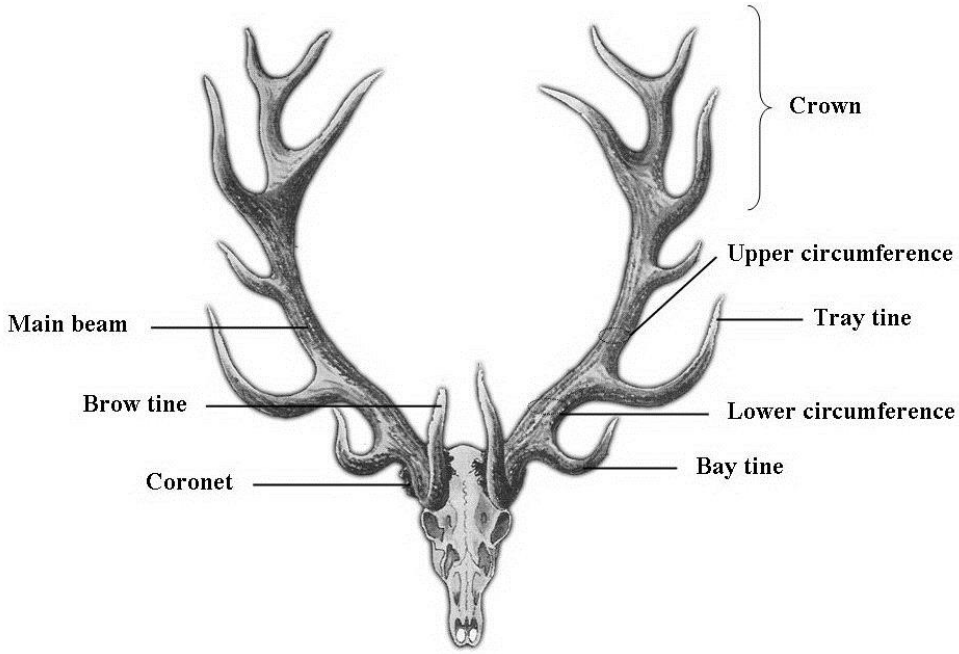

Figure 1
The measured parameters of a red deer trophy (by Szederjei, 1960)

The trophy parameters are multiplied by different weights in the CIC score system. The multipliers and score intervals of the red deer trophy parameters in the CIC score system are shown in table 1. The bay tines get only maximum 2 scores (but it is always measured) (Szidnai, 1978).

Table 1
The multipliers and score intervals of the red deer trophies' parameters in the CIC score system.

The parameters of red deer trophy	Multiplier and scores intervals
Mean of the length of main beams (cm)	x 0,5
Mean of the length of brow tines (cm)	x 0,25
Mean of the length of tray tines (cm)	x 0,25
Mean of the circumference of coronets (cm)	x 1
Mean of the circumference lower beams (cm)	x 1
Mean of the circumference upper beams (cm)	x 1
Weight of (dry) antler (kg)	x 2

Number of total tines (pieces)	x 1
Colour	0 – 2
Pearls	0 – 2
Spread of the main beams	0 – 3
Crown	0 – 10
The bay tines	0 – 2
The end of the tines	0 – 2
Mistake scores	0 – 3
Correction	1 – 3

Due to the multipliers the trophy's parameters account for different percentages of the total CIC scores. The weight of the antler usually provide 8 – 12 percents-, the mean of the main beams 20 – 25 percents-, the brow tine 5 percents-, the bay tine 1 percent-, the tray tine 6 percents-, the spread of the antler 1 percent-, the number of the crown 8 – 12 percents-, the circumference of the coronet 10 percents-, the lower circumferences 15 – 16 percents-, the upper circumferences 14 – 15 percents of the total CIC scores (Bán, 1986).

The objectives of our study were twofold, to examine the changes in the trophy parameters in this 10 year of period in these two counties to evaluate and transfer the trophy parameters into a smaller set of (uncorrelated) factors to make an easier way for selection for the hunters. In Arabian horses there was used same method for grouping body measurements (Shadek et al., 2006). Posta et al., (2007) made some research on 18 performance traits of Hungarian Sporthorse mares by factor analysis.

Material and methods

Data

All data of the Hungarian red deer's trophy parameters were collected by the National Game Management Database of Hungary between 1997 and 2007. The sources of the data were two areas of Somogy and Bács-Kiskun counties sized 5939 km^2, and 3893 km^2 respectively. These counties are located at Southern Transdanubia, and Southern Great Plain respectively. They represent two distinctly different ecosystem. The present study considered only the records of the awarded (>190 CIC score) trophies. In case of trophies which were not awarded are only measured the weight and the length of main beam, this is why they have been thrown out of the analysis. The dataset contained antler parameters of 6868 stags (4-16 years of age). There were not used age categories (young, middle and old), because the young category (2-3 years of age) was missing. Therefore there were used the estimated age in the analysis (the error in all category is the same level).

Antler parameters

Among the trophy parameters forming the basis for calculating the CIC score the following traits were used:

- *Mean of the length of main beams (cm)* is measured along the outside edge of the base of the coronet to the end of the longest tine in the crown.

- *Mean of the length of brow tines (cm)* is measured along the underside of the tine from the upper edge of the coronet to the extremity of the tine.

- *Mean of the bay tines (cm)* is measured along the underside of the tine, from the place where it starts to emerge from the main beam to the extremity of the tine.

- *Mean of the length of tray tines* (cm), this was measured along the underside of the tine, from the place where it starts to emerge from the main beam to the extremity of the tine.

- *Weight of (dry) antler (kg)* is measured with a precision of 10 grams and the measurement is taken 24 hours after the trophy was cooked.

- *Mean of the circumference of coronets (cm)*.

- *Mean of the circumference lower beams (cm)* is measured at the thinnest place between brow, and tray tines respectively.

- *Mean of the circumference upper beams (cm)* is measured at the thinnest place between the tray tine, and crown tines respectively;

- *Number of total tines (ps)* (International Council for Game and Wildlife Conservation, 2012).

From the trophy parameters the colour, pearling, spread of the main beam, the crown and the end of the tines were not used in the analysis, because they do not represent considerable part of CIC scores and all these parameters are based on subjective judgement.

Statistical analysis

To study the effects of county and age on the antler parameters, data were analysed using general linear model procedure of SAS (PROC GLM) according to the model:

$$y_{ij} = \mu + sj + b(X_{ij} - \bar{X}) + e_{ij}$$

where y_{ij} is the observation of one of the 9 studied traits of the stag *i* of county *j*; μ is the overall mean; *sj* is the fixed effect of county of animal; b is the regression coefficient; X_{ij} is the observation of age of stag i of the country j in years; $\bar{X}$ is a mean age of stags; and e_{ij} is the random residual term.

Correlation between parameters adjusted for age effect were estimated using partial correlation of SAS (PROC CORR). The dimension of the antler parameters were reduced applying the principal component analysis (PROC FACTOR) and using varimax rotation creating orthogonal (uncorrelated) components (Cody et al., 1997).

Results

Descriptive statistics

The distribution of the stags across the age categories is given on Figure 2. Most of the trophies were shot between 7 and 10 years of age. The percentage of the bronze, silver and gold medal awarded trophies were 52.2 and 53.6%, 36.2 and 37.4% and 11.6 and 9% in Somogy, and in Bács-Kiskun counties respectively.

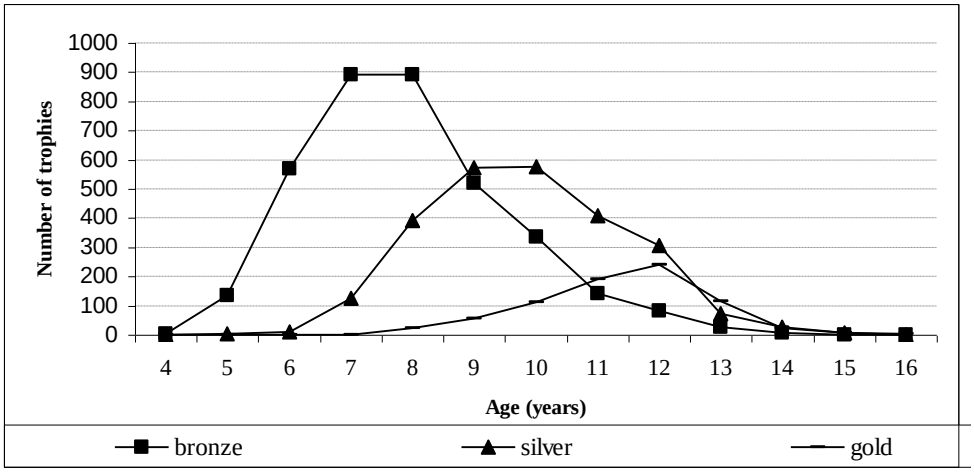

Figure 2
The distribution of the awarded trophies between the age categories

During the examined period the number of shot stags in each year continuously increased from 363 in 1997 to 796 in 2007. The number of shot stags in each year is presented on figure 3.

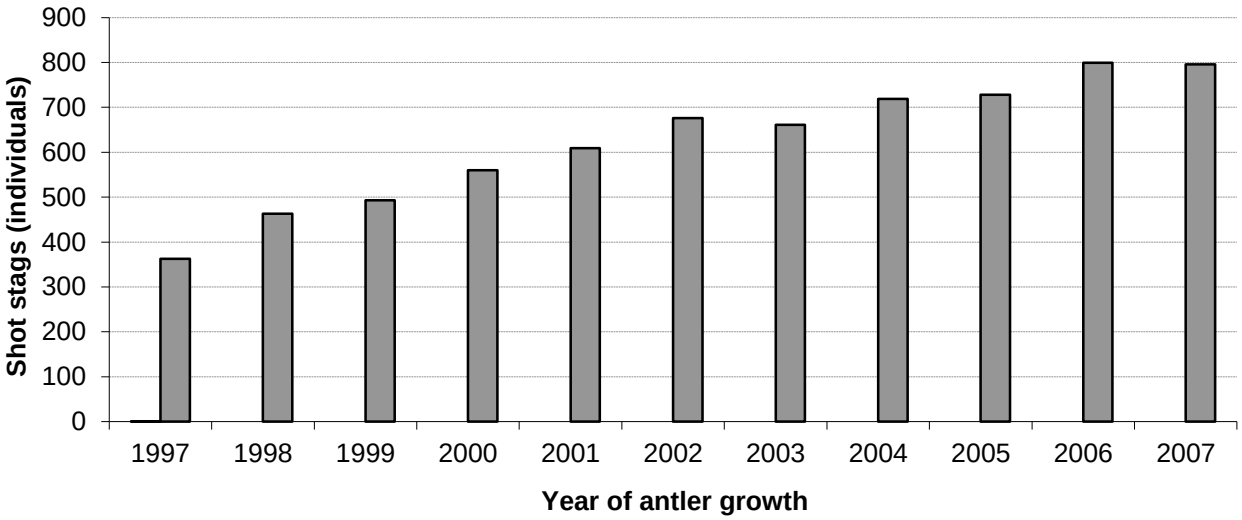

Figure 3
The number of shot awarded stags in each year during the examined period

In spite of the increasing of the number of shot stags in each year, the averages of trophy parameters were not shown any decrease during 10 years, except the age of the stags. The average of age of the shot stags decreased from 9.79 year of age to 8.31 year of age during the studied period. The changes of age of the shot stags and trophy weight from 1997 to 2007 are depicted in figure 4.

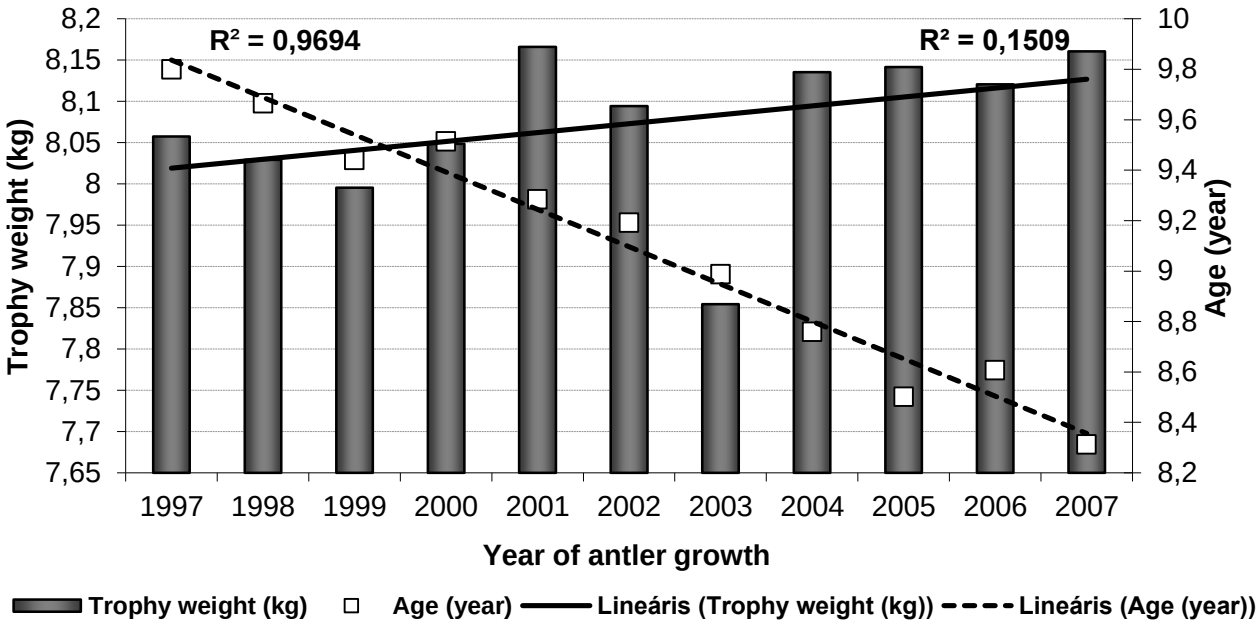

Figure 4
The changes of age of the shot stags and trophy weight from 1997 to 2007

The means of the 9 parameters from 1997 to 2007 in both counties are presented in Table 2.

The weight (10.33 kg) of the gold medal trophies, the number of total tines per beam (7.50) and the mean of the circumference of upper beam (15.77 cm) showed lower values between 1965 and 1981 (Bod, 1994) than between 1997 and 2007 in Somogy county (Table 2). On the other hand, the other parameters – mean of the length of main beam (111.50 cm), the mean of the length of brow tines (42.87 cm), the mean of the length of the bay tines (32.77 cm), the mean of the length of the tray tines (43.70 cm), the mean of the circumference of coronets (28.24 cm), the mean of the circumference of lower beam (17.20 cm), – were longer between 1965 and 1981 (Bod, 1994) than between 1997 and 2007 in Somogy county (Table 2).

Table 2
The means of the antler parameters

Parameters	Bács-Kiskun County			Somogy County		
	Bronze	Silver	Gold	Bronze	Silver	Gold
Weight of (dry) antler (kg)	7.09	8.71	10.62	7.12	8.67	10.68
Length of main beams (cm)	97.55	104.04	107.81	98.91	105.01	109.80
Length of brow tines (cm)	35.94	39.06	42.40	34.97	37.67	40.71
Length of bay tines (cm)	21.12	25.75	28.75	19.54	23.97	28.96
Length of tray tines (cm)	30.77	36.00	40.60	33.69	38.10	43.13
Circumference of coronets (cm)	24.34	26.19	28.33	24.44	25.97	27.87
Circumference of lower beam (cm)	14.53	15.75	17.35	14.58	15.68	17.05
Circumference of upper beam (cm)	13.23	14.46	16.18	13.29	14.40	15.79

Number of total tines per beam	6.05	6.88	7.84	5.94	6.77	7.90
Mean of age	8.04	9.88	11.12	7.89	9.84	11.39
Number of records	494	344	83	3105	2154	687

The age effect on the trophy parameters

Almost all parameters grow together with the age up to 12 -14 years. After this time the parameters usually start to decrease slowly. The highest recessions occur in the cases of length of brow- bay- and tray tines. The weight-, the circumferences- and the length of the main beam of the trophies usually stagnate or slightly decrease which however do not reduce the CIC points substantially. There was one trophy of a 16 year old stag that showed exceptionally high performances for almost all parameters. In case of all parameters significant ($P<0.05$) age effects were found. The means of the trophy's parameters for each age group are presented in Table 3.

Table 3
The means of the trophy parameters in every age category

	Least squares means								
Age (year)	Weight of the antler (kg)	Circumference of coronet (cm)	Circumference of lower beam (cm)	Circumference of upper beam (cm)	Length of the main beam (cm)	Length of the brow tine (cm)	Length of the bay tine (cm)	Length of the tray tine (cm)	Number of total tines per main beam (cm)
4	6.13	23.10	14.41	13.84	84.71	37.16	25.32	29.94	6.04
5	6.56	23.56	14.31	13.09	93.91	34.26	21.98	32.90	6.24
6	6.68	23.79	14.34	13.00	95.50	35.40	22.00	32.65	5.98
7	7.09	24.11	14.56	13.25	98.01	35.95	21.60	33.21	6.08
8	7.63	24.85	15.00	13.72	100.24	36.64	22.33	34.29	6.32
9	8.11	25.47	15.30	14.02	102.02	37.23	23.04	34.89	6.50
10	8.46	26.02	15.56	14.24	103.59	37.93	23.35	35.81	6.59
11	8.97	26.63	15.87	14.58	105.24	38.70	24.02	36.88	6.93
12	9.42	26.88	16.09	14.90	106.53	38.93	25.38	37.76	7.10
13	9.96	27.76	16.45	15.24	107.70	38.62	23.42	38.24	7.24
14	9.59	27.15	16.00	15.09	108.45	34.99	19.18	35.33	7.17
15	9.53	26.14	15.60	14.31	108.60	36.33	18.38	33.68	7.46
16	10.79	29.57	19.12	17.00	107.54	28.67	10.02	28.20	6.32

The "county effect" on the trophy parameters

The means of the trophy parameters and their differences between the counties are shown in Table 4.

There were significant differences between the two counties for lengths of main beams, lengths of brow tines, length of bay tines, length of tray tines and the number of tines per main beam. In the case of all parameters, where significant differences were found - except the length of the main beam – higher values were recorded for animals originated from Bács-Kiskun county.

Table 4
The means of trophies' parameters in both counties

Parameters	Least squares means		
	Bács-Kiskun County	Somogy County	MSE
Weight of (dry) antler	8.22[a]	8.28[a]	1.08
Length of main beams	101.32[a]	102.87[b]	6.41
Length of brow tines	37.4[a]	36.32[b]	5.67
Length of bay tines	23.26[a]	21.89[b]	11.33
Length of tray tines	32.78[a]	35.49[b]	7.28
Circumference of coronets	25.62[a]	25.61[a]	2.23
Circumference of lower beam	15.35[a]	15.36[a]	1.46
Circumference of upper beam	14.32[a]	14.34[a]	1.34
Number of total tines per main beam	6.65[a]	6.58[b]	1.06

1 Mean values with same superscript were not significantly different between the counties (P<0,05).

Correlations

The partial correlations between trophy parameters are given in Table 5. There were significant differences between the two counties, due to this reason correlations were estimated and shown separately in Table 5. The tendencies of the correlation coefficients between the trophy parameters however were similar in both counties.

High correlations were found between the lower and upper circumferences (r=0.80) and medium between the coronet circumference and lower (r=0.66) and upper (r=0.62) circumferences in Somogy county. In Bács-Kiskun county there were found lower correlations between lower and upper circumferences (r=0.70) and the coronet circumference and lower (r=0.48) and upper (r=0.47) circumferences.

Table 5
Pearson correlations between parameters[1] for red deer trophies of Somogy[2] (below diagonal) and Bács-Kiskun[3] (above diagonal) Counties adjusted for age effect

	V1	V2	V3	V4	V5	V6	V7	V8	V9
V1		0.35	0.32	0.29	0.38	0.43	0.42	0.48	0.60
V2	0.33		0.17	0.04	0.07	-0.06	0.14	0.12	0.15
V3	0.30	0.13		0.28	0.31	0.15	0.19	0.13	0.15
V4	0.33	0.04	0.24		0.35	0.31	0.14	0.00	0.04
V5	0.38	0.04	0.34	0.32		0.33	0.11	0.20	0.12
V6	0.43	-0.04	0.10	0.29	0.24		0.09	0.11	0.25
V7	0.33	0.07	0.35	0.17	0.30	0.04		0.48	0.47
V8	0.41	0.11	0.30	0.11	0.41	0.10	0.66		0.70
V9	0.49	0.10	0.34	0.15	0.32	0.20	0.62	0.80	

[1]V1: Weight of (dry) antler; V2: Length of main beams; V3: Length of brow tines; V4: Length of bay tines; V5: Length of tray tines; V6: Number of total tines per beam; V7: Circumference of coronets; V8: Circumference of lower beam; V9: Circumference of upper beam
[2] All estimates were significant (p>0.05); number of trophies in Somogy = 5946.
[3] All estimates were significant (p>0.05), except V2 – V4 V4 – V8 and V4 – V9; number of trophies in Bács-Kiskun = 920.

All parameters had medium correlation with the weight of the trophy in Somogy county. In Bács-Kiskun county the relation between the weight of the trophy and the other parameters were same except the upper circumference. This was higher (r=0.6) than in Somogy county (r=0.49). The length of main beams was in low correlation with the other trophy parameters in both county.

Principal component analysis

As there were significant differences between the two counties in the cases of 5 parameters, the principal component analysis was conducted separately for each county.

Estimated factor loadings extracted by principal component analysis, eigenvalues, variation are explained by each factor presented for in Table 6, and 7 for Somogy and Bács-Kiskun county respectively. There were four factors with eigenvalues accounting for 73 % and 75 % of the total variance in Bács-Kiskun and Somogy county.

Table 6
Estimated factor loadings extracted by principal component analysis using orthogonal (varimax) rotation in Bács-Kiskun county

	Factors				
Measurements	1	2	3	4	Communality
Weight of antler	0.57	0.26	0.49	0.40	0.80
Length of main beam	0.08	0.08	-0.05	0.97	0.95
Length of the brow tine	0.17	0.80	-0.10	0.15	0.71
Length of bay tine	-0.05	0.68	0.36	-0.04	0.59
Length of tray tine	0.08	0.56	0.46	0.05	0.53
Number of total tines per beam	0.10	0.12	0.88	-0.07	0.81
Circumference of coronets	0.75	0.25	-0.12	-0.01	0.64
Cricumference of lower beam	0.87	-0.01	0.08	0.04	0.76
Circumference of upper beam	0.85	-0.05	0.25	0.12	0.81
Eigenvalues	3.14	1.55	1.09	0.81	
Variation	2.42	1.57	1.46	1.15	

Table 7
Estimated factor loadings extracted by principal component analysis using orthogonal (varimax) rotation in Somogy county

	Factors				
Measurements	1	2	3	4	Communality
Weight of antler	0.39	0.26	0.59	0.45	0.77
Length of main beam	0.03	0.03	-0.02	0.96	0.93

Length of the brow tine	0.28	0.74	-0.16	0.16	0.68
Length of bay tine	-0.06	0.70	0.38	0.00	0.63
Length of tray tine	0.32	0.62	0.23	-0.05	0.55
Number of total tines per beam	0.04	0.11	0.89	-0.07	0.82
Circumference of coronets	0.81	0.24	-0.67	0.02	0.71
Cricumference of lower beam	0.91	0.12	0.08	0.06	0.85
Circumference of upper beam	0.88	0.10	0.20	0.08	0.84
Eigenvalues	3.43	1.37	1.08	0.89	
Variation	2.59	1.59	1.42	1.18	

In Bács-Kiskun county the first factor accounted for 35 % of the total variability of the original 9 measurements. This factor seemed to represent the weight and the circumferences. The second factor accounted for 17 % of the total variation. It had high loadings for the main tines' measurements and it seems to represent the tine lengths. The third factor accounted for 12 % of the total variation. It contained high loadings for the number of total tines per beam. The fourth factor accounted for 9 % of the total variation. It comprised the length of main beam. The communality estimates for the 9 measurements in Bács-Kiskun county ranged from 0.53 to 0.95. The four factors are shown in Figure 5 in rotated space in Bács-Kiskun county.

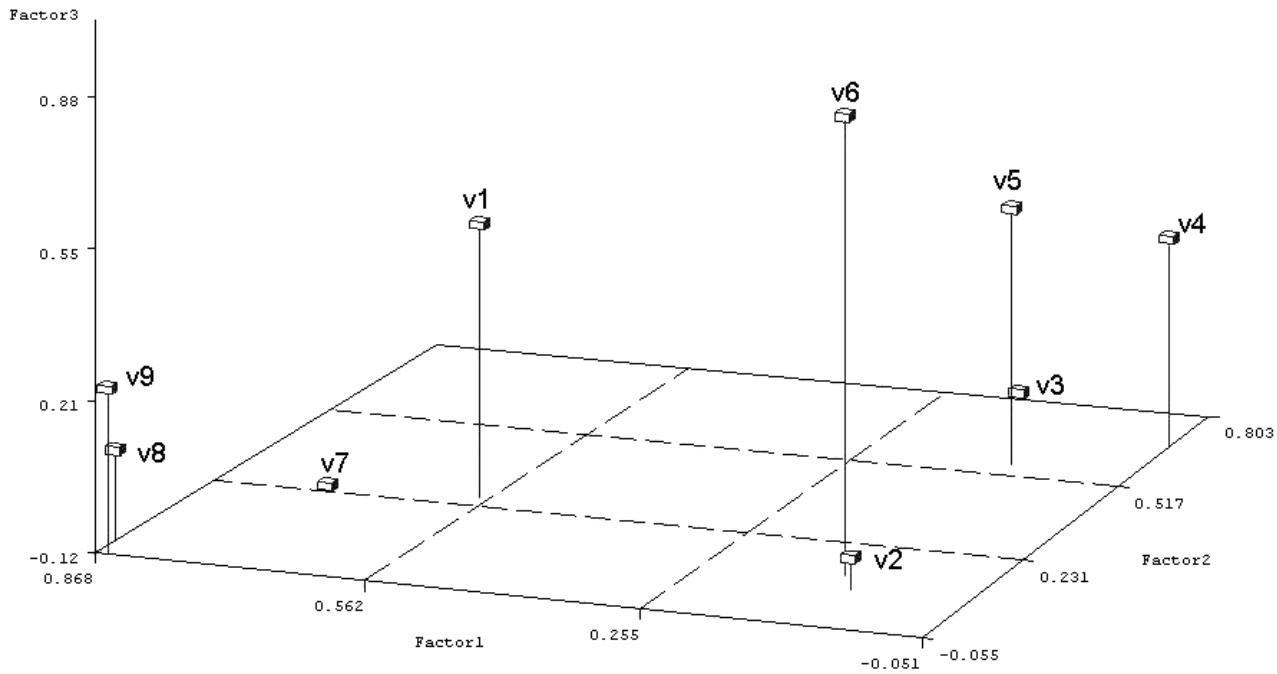

Figure 5
Factor plot in rotated space for the trophy parameters of Bács-Kiskun county. v1, weight of antler; v2, length of the main beam; v3, length of brow tines; v4, length of

bay tines; v5, length of tray tines; v6, number of total tines per beam; v7, circumference of coronets; v8, circumference of lower beam; v9, circumference of upper beam

In Somogy county the first factor accounted for 38 % of the total variability of the original 9 measurements. This factor seemed to represent the circumferences. The second factor accounted for 15 % of total variation. It had high loadings for main tines' length. The third factor accounted for 12 % of the total variability. It contained high loadings for the number of total tines and the weight. The fourth factor accounted for 9 % of the total variation. It comprised high loadings for the length of the main beam. The communality estimates for the 9 measurements in Somogy county ranged between 0.54 and 0.93. The four factors are presented in Figure 6 in rotated space in Somogy county.

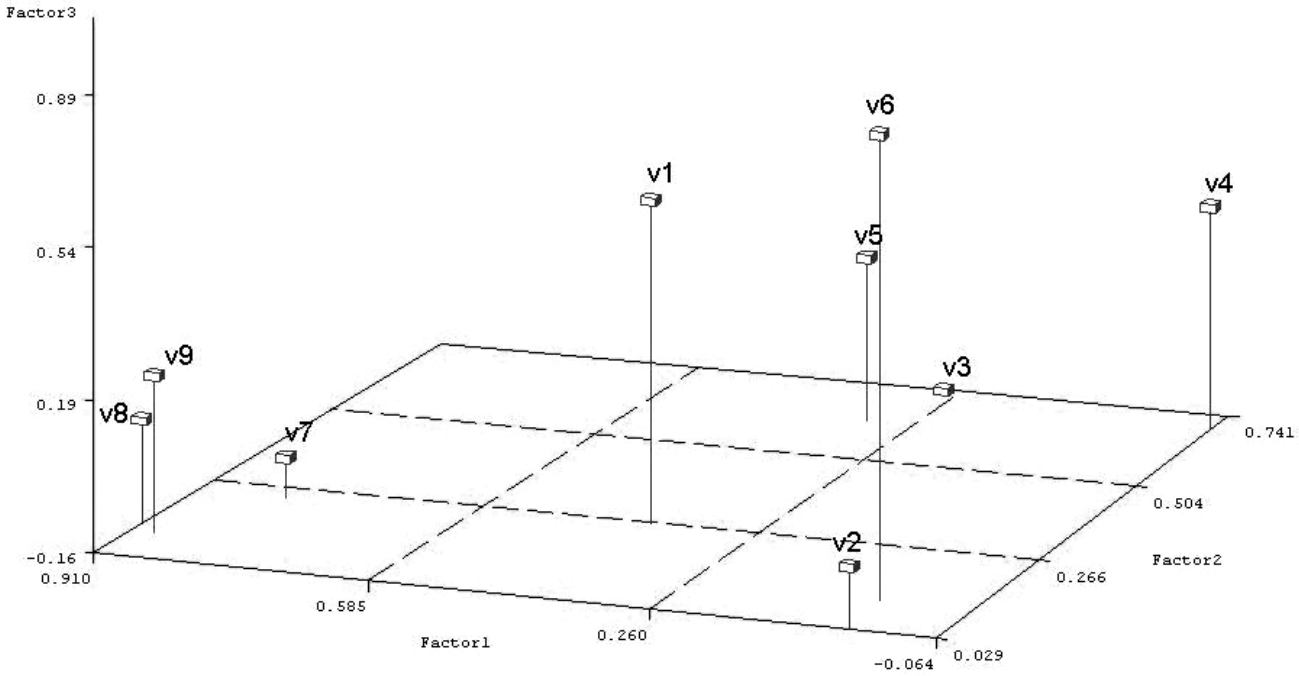

Figure 6
Factor plot in rotated space for the trophy parameters of Somogy county. v1, weight of antler; v2, length of the main beam; v3, length of brow tines; v4, length of bay tines; v5, length of tray tines; v6, number of total tines per beam; v7, circumference of coronets; v8, circumference of lower beam; v9, circumference of upper beam

Discussions

Barna et al. (2009) recognized that the population size of red deer in Somogy county dropped down seriously from 1969 to 2008. Probably the background of this study is the change of the hunting low in 2002 (abrogated the negative scores). Authors (Barna et al., 2009) predicted, that the effect of the decreased population size will be appeared in the lower trophy quality in the following years.

The changes of age and trophy weight between 1997 and 2007 probably due to the increase of number of the shot stags. It is surprising there were no decrease either of

trophy parameters and the number of trophies over 230 scores increased from 4 in 1997 to 15 in 2007. Before the abrogation of negative scores in 2002 it was low number of high score's trophy than it increased. In the background of this can be found that the young stags with great trophy potential could reach 220 CIC scores easily in younger age (7-8 years). In the case of these stags if they will be shot several years later (in 12 year of age), trophies of them can scored probably over 240 CIC points.

Since the younger age categories were shot earlier, these stags will miss in the following years. The stag population is getting more and more younger, if it will show the same trend it will probably result the decrease in trophy parameters.

The trophy parameters change in the different age categories. At 15 months of age the male red deer (stag) usually has just the main beams (20 - 60 cm), sometimes one or two points (tines). From the age of two years the stags have the main tines (brow-, bay- and tray tines), two or three tines in the crown and the coronets on their antlers. At this age the main beams are 40 - 70 cm long (Bán, 1986). All the trophy (antler) parameters grow with the age. The Hungarian red deer stags have the greatest trophy in 12-13 year of age. From this time certain parameters start to slow down (Faragó, 1994). The results of this study fit with these.

These result should be complete with data from a small population where can collect the casted antlers year to year and describe the antler growth from the first year to 10 or 12 year of age.

The differences between the two counties might be due to the genetic differences between the populations and due to environmental factors (flora, fauna, moisture, number of sunny days, dimensions of agricultural lands). The relationship between the wildlife and flora, fauna and soil was exanimated by Bencze (1972). The number of sunny days and humidity have positive correlation with antler size but the rain fall (flood) have negative effect on the antler growth (Szederjei, 1960).

The results between the weight and the other parameters are lower than Nagy et al., (2005) found between the weight of the trophy and circumferences (r_{lower}=0.66, r_{upper}=0.74 $r_{coronet}$=0.68) and between the weight of the trophy and the length of the main beam (r=0.80) in Somogy county. The reason of these differences is probably that Nagy et al., (2005) made the analysis at all the hunted red deer trophies (not only the records of the awarded trophies) from 1974 to 2001.

The first factor was highly loaded for the circumferences of coronets, the lower and the upper circumferences. It tends to represent the circumferences of the trophy. The second factor had high loading values for length of brow tines, length of bay tines and length of tray tines. This factor represented the main tines of the antler. The third factor represented only by the total tine number of the trophy. The fourth factor represented just by the length of main beam. On the basic of these, there were found four feature groups in the basic of the factor analysis' results in both counties. The first includes the circumferences, the second the length of the main tines, the third the number of total tines and the fourth the length of the main beam. The difference between the counties is in the case of classing antler's weight. In Bács-Kiskun county the weight has the highest pattern in the first factor with the circumferences. In Somogy county this parameter has the highest value in the third factor with the number of total tines. The four groups are similar in both counties except the weight of the antler.

Four extracted factors for both counties determine the main sources of shared variability that controls trophy conformation in Hungarian red deer. These factors seemed to represent the trophy circumferences, the length of main tines, the total number of tines and the length of the main beam. These factors could be considered in selection/evaluation of the trophies in Hungarian red deer instead of the original measurements and in order to maintain the type of Hungarian red deer trophy. Probably each group can be a selection way. The background of the groups can be research topic on molecular genetic way (the genes of the parameters of the same group can be close).

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