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CHARACTERISTICS OF MORPHOLOGICAL PARAMETERS OF DONKEYS IN THE CZECH REPUBLIC

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Abstract

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The donkey population in Central Europe and Czech Republic is very variation, which is a consequence of the donkeys originating from various areas of Europe. This has been proved to affect their body conformation. In this work, we are focusing on the population of donkeys in the Czech Republic and its analysis.

The main aim of our work was to determine the values morphological parameters in the donkey population in the Czech Republic. Altogether, 23 body dimensions were taken and further processed to calculate 6 hippo metric indexes. The sample group we analyzed consisted by a total of 70 individuals, out of there were 23 stallions and 47 mares. The results were then processed using the methods of general linear model (GLM) and multiple comparisons.

We managed to prove a statistically significant influence of the sex factor for the following body measurements: shin length of the front limbs, chest width, withers height measured by tape, shin circumference on both front and pelvic limbs and also for weight index. Also, we have found a statistically significant difference in the scapula length when considering the age factor.

Keywords: donkeys, body basic parameters, hippo metric indexes

INTRODUCTION

The ancestors of present donkeys, evolved on a relatively small and specific areas in Northern Africa. There are a few significant factors typical for these areas; high daily temperatures, minimal amount of precipitation and lack of quality nutriment. These specific conditions of the African continent enabled do donkeys to develop a typical habit, which played a key role in order to survive in dry locations (Pearson, R. A., Ouassat, M., 2000). Also, in some parts of the Northern Africa, the human civilization was developing. Donkeys, for example, helped to accelerate the advancement of Egypt, by being crucial helping force in agriculture and logistics. Being essential for ancient civilizations; donkeys have spread throughout the world very quickly. In present times, they are welcome helpers because of their unbelievable doggedness and ability to survive (Beja-Pereira *et al.*, 2004).

Having spread around the world and being bred in different local conditions, donkeys started to diversify, which has later become a basis for various breeds and natures. During domestication, some morphological and genetic changes have taken place in order for donkeys to survive better in given conditions (Rossel *et al.*, 2008).

The origin of donkeys imported into our country is unknown in most cases. The individuals are being imported mostly from Romania, Hungary and Bulgaria, but there are also individuals from Germany, Ireland, France and other western countries. The donkey population in the Czech Republic is a relatively small group of individuals

with poorly known relationships to each other. This can be thought of a as a consequence of uncontrolled import and breeding of donkeys.

Recently, donkey breeding is becoming more popular in the Czech Republic as donkeys are used for free time and recreational activities. The records of Central Horse Register prove that donkey population in the Czech Republic is on a rise. The most recent figures show more than 400 donkey individuals, which means about 25% growth during last two years.

MATERIALS AND METHODS

A database of donkey individuals in the Czech Republic has been created based both on data provided by the Central Horse Register (located in Slatiňany) and on contacts given to us by donkey owners themselves.

In total of 23 body measurements were measured and 6 hippo metric indexes were calculated.

Throughout the research, the same gauges were used and all animals were measured by the same person. This was to eliminate or minimize the subjective divergence of measurements. Height values were taken with the cane rate being always upright to the surface. Any deviation from the upright angle would distort the out coming results, making them useless for further research. When taking the width measurements, it is necessary to apply the same adhesion and tightening of the gauge.

Each measurement was performed three times; an average from these three values was then used for further processing.

The following body measurements were further examined:

- withers height (cane) (WHc),
- withers height (tape) (WHt),
- back height (BH),
- croup height (CH),
- tail base height (TBH),
- sternum height (SH),
- chest depth (CD),
- chest width (CW),
- chest circumference (CC),
- head length (HL),
- trunk length (TL),
- loin length (LL),
- pelvis length (PL),
- shin circumference in pelvic limb (SCPL),
- shin length in pelvic limb (SLPL),
- fetlock length in pelvic limb (FLPL),
- length of shoulder-blade (LSB),
- ante brachium length (ABL),
- shin length in front limb (SLFL),
- fetlock length in front limb (FLFL),
- chest width (CW),
- frontal width of pelvis (FWP),
- shin circumference in frontal limb(SCFL).

The following hippo metric indexes were then calculated:

- body format index (BFI),
- body dumpiness index (BDI),
- body robustness index (BRI),
- boniness index (BI),
- head size index (HSI).
- index of sternum-surface distance(SSDI).

Data were collected and recorded in Microsoft Excel 2007 software.

We have analyzed the following factors:

- **Sex**: donkey stallions (n = 23), donkey mares (n = 47)
- **Age of individuals:** the animals were separated into two groups based on their age:
  - Group 1: donkeys aged 3–5 years (n = 39)
  - Group 2: donkeys aged 5+ (n = 31)

The influence on body measurements was tested using the General Linear Model (GLM). We used Unistat 5.1 for data processing and whenever a statistically significant difference was found, the actual difference for the given factor was specified using the Turkey-B multiple comparison test. Furthermore, the Pearson's correlation test was used to identify the links between body measurements. The correlation has its own coefficient, which ranges from –1 to 1. When the values are not related at all the coefficient will be 0, contrary to that values closing in on 1 suggest a possible link between the values.

RESULTS AND DISCUSSION

A morphological profile of donkeys living in the Czech Republic has been crested on the basis of measurements and hippo metric indexes mentioned above. This is to help us determine the breeding potential of each donkey individual by judging its exterior. As mentioned before, donkeys are not an original species in the Czech Republic; it is an imported species, which is often dependent on a current importing trend. In the past, donkeys were difficult to find and therefore breeders were happy for any available individual. However, some trends have arisen recently, which is resulting in donkeys imported from different parts of the world. Another consequence is a relatively high variance in the morphology of the population. The current population of donkeys in the Czech Republic shows higher phenotype variance compared to original populations of donkeys.

The withers height, for example, is most probably influenced by the origin of the given individual, as it can be an adaptation to specific conditions of that place. The cause of these differences can be found in different domestication families of the population (Beja-Pereira *et al.*, 2004). Also Kefena *et al.* (2004) points out the importance of ecology and biophysical resources for the overall body build. Gubitz *et al.* (2000) proved that the body

constitution and hair color have changed to reflect the local environment and history. Adaptation to the environment based on local climate and geography has also been documented in other animal species (Demetrius, 2000).

The body measurements taken and the hippo metric indexes calculated have undergone tests of the General Linear Model, which has proved a statistically conclusive difference for sex factor ($P < 0.05$) for the following measurements: shin length in frontal limb, chest width, withers height (tape), shin circumference in frontal and pelvic limb. Processing Scapula length values has identified a statistically conclusive difference for the age factor (values marked by asterisk in Tab. I).Statistically highly conclusive difference ($P < 0.01$) has not been identified.

As mentioned above, a statistically conclusive difference has been found in withers height and shin circumference. This confirms earlier findings of Folch and Jordana (1997), who have suggested there is a sexual dimorphism in Catalonian donkeys. There are specific physiological and biochemical processes in male donkey individuals, which results in them being different from mares (Andersson 1994 in Purzyc, Kobryn', Komosa and Bojarski, 2007). In general, male donkeys have lower chest circumference and stronger shin. The chest circumference in female individuals is mainly influenced by physiological processes during gestation and by metabolic traits that differ from those in males (Koubek *et al.*, 1933). The interesting fact, though, is that after widening the spectrum of examined individuals, these statistically significant conclusions have not been proved. This occurrence might be caused by various things – first of all, the chest circumference is one of the most variable values measured in donkeys. It is influenced by the overall health of the individual, eventual gestation phase etc. On the other hand, the statistically conclusive difference has been found in wither height (tape), which is considered a reflection of withers height (cane) and the overall body constitution of an individual (Koubek *et al.*, 1933).

According to Kefena *et al.* (2011), there are no explicit anatomic differences or sexual dimorphism in donkeys. Koch (1954) points out, that sexual dimorphism in horses is not expressive, similarly to other mammal species (rabbits, guinea pigs etc.) However, it can be observed in many animal taxons. Usually, the dimorphism markers are more distinctive in males, while females only have these traits in tender form. In present days, some sex-based differences in biometric traits are observed in horses (Purzyc, Kobrynćzuk and Bojarski, 2007).

The multiple comparison test has shown a statistically conclusive difference for the sex factor in males and females. On average, there was a difference of two centimeters in the shin circumference in pelvic limb and more than one centimeter in shin circumference in frontal limb. The shin circumference in males shows higher average values than in females. Stallions have stronger shin in order to keep the skeleton strength considering other body measurements. Our file has shown a statistically conclusive difference of boniness index between males and females. This might be a conclusion of the shin circumference being used as one of the factors in the calculation.

Using the General Linear Model, a statistically conclusive difference ($P < 0.05$) has also been found in the scapula length considering the age factor. For the first group of donkeys (aged 3–5 years), the length is 37.15 cm on average, whilst the other group (aged 5+) shows an average of 38.6 cm. Donkeys belong to animal species, which ripen later, their growth terminates after 5 years of life. Regardless of that there have not been any other values with statistically conclusive difference between the two age groups, therefore it is assumed this confirmation is a coincidence.

Pearson's Correlation

A total of 23 body measurements were subjected to Pearson's correlation (Tab. II). A positive correlation was found in all values, suggesting that if one value rises, other values will do the same. Negative correlations have not been found, which is an opposite to work of Foch and Jordana (1997). In the table, linkages of all body measurements to withers height can be observed. There is also a comparison to Foch and Jordana (1997). In general, our values have shown tight linkages between body measurements. The truth is, however, we did not compare male and female population; we were only trying to depict the population of donkeys living in the Czech Republic in general. Thus, our work might have resulted in a different outcome.

CONCLUSION

The main goal of this work was to create a basic template for typological analysis of donkeys on the Czech Republic. This template should further serve for breeding activities. The body measurements were taken in 23 donkey stallions and 47 donkey mares older than 3 years of age as it is assumed the overall growth of the individual is not so significant afterwards. The population was analyzed per two factors; sex factor and age factor. The final statistical evaluation was performed with usage if the General Linear Model (GLM).

A statistically conclusive difference between genders has been proved for the following body measurements: withers height (tape), scapula length, chest width, shin circumference both in anterior and pelvic limb and shin length in anterior limb. Even though there is no distinctive sexual

I: *Evaluation of the 23 body parameters and hippometric indexes*

	average			max.			min.			standard deviation			median		
	pop.	**stallions**	**mares**	**pop.**	**stallions**	**mares**	**pop.**	**stallions**	**mares**	**pop.**	**stallions**	**mares**	**pop.**	**stallions**	**mares**
WHc	107.5	109.9	106.0	131.0	131.0	121.0	94.0	98.0	94.0	8.2	8.6	7.5	106.0	107.0	103.8
BH	105.5	107.7	104.2	130.0	130.0	118.0	91.5	97.0	91.5	8.1	8.8	7.2	104.0	105.5	102.0
CH	110.7	112.4	109.56	139.0	139.0	126.0	95.0	103.0	95.0	8.4	9.6	7.2	108.5	109.0	108.3
TBH	99.4	100.7	98.4	125.0	125.0	112.0	81.0	87.0	81.0	8.9	9.9	8.0	98.0	98.0	97.5
SH	58.1	59.7	57.0	72.5	72.5	68.0	49.0	50.0	49.0	5.2	5.0	5.1	58.0	59.0	55.3
CD	49.5	50.2	49.0	58.5	58.5	55.0	43.0	43.5	43.0	4.0	4.6	3.4	49.0	49.0	49.0
CW	27.5*	29.7	26.1	34.5	34.5	30.0	22.0	25.0	22.0	3.0	2.7	2.2	27.0	30.0	26.3
CW	31.0	32.4	30.1	38.0	38.0	37.5	22.5	27.0	22.5	4.0	3.4	4.2	31.0	31.0	31.0
FWP	36.1	37.1	35.5	44.0	44.0	40.5	30.5	33.5	30.5	3.0	2.7	3.0	36.0	37.0	35.0
WHt	116.5*	119.9	114.4	143.0	143.0	131.0	100.0	106.0	100.0	8.8	9.0	7.9	115.0	117.0	114.5
CC	129.5	132.9	127.2	155.0	155.0	143.0	111.0	118.5	111.0	10.8	11.3	9.9	129.0	132.0	127.0
HL	44.4	45.2	43.8	54.0	54.0	53.0	37.5	37.5	37.5	3.6	3.7	3.4	44.0	45.0	43.0
TL	113.3	116.1	111.5	145.0	145.0	128.0	101.0	106.0	101.0	8.6	9.6	7.3	111.5	115.0	110.5
LL	13.0	13.2	12.9	17.5	17.5	16.5	9.5	10.0	9.5	2.0	2.0	1.9	13.0	13.0	13.0
PL	32.6	33.2	32.2	38.0	38.0	36.0	27.0	28.0	27.0	2.7	2.9	2.5	33.0	33.5	32.8
SCPL	15.5*	16.9	14.7	22.0	22.0	20.0	11.0	14.0	11.0	2.5	2.8	1.9	15.0	15.5	15.0
SLPL	30.5	32.0	29.6	40.0	40.0	34.5	25.5	28.5	25.5	2.8	3.0	2.1	30.5	31.5	29.0
FLPL	8.3	8.4	8.3	11.0	11.0	11.0	7.0	7.0	7.0	1.0	1.0	0.9	8.0	8.0	8.0
LSB	37.8*	39.4	36.9	47.0	47.0	43.0	33.0	36.5	33.0	3.0	3.1	2.5	38.0	38.0	37.0
ABL	32.4	33.3	31.9	42.0	42.0	37.5	25.0	27.5	25.0	3.6	3.5	3.5	33.0	33.0	32.3
SLFL	21.8*	21.9	21.8	29.0	26.5	29.0	17.0	17.0	18.5	2.4	2.2	2.5	21.0	21.5	21.0
FLFL	8.3	8.5	8.2	11.0	11.0	11.0	6.5	7.0	6.5	1.0	0.9	1.0	8.0	8.5	8.0
SCFL	13.9*	14.7	13.3	18.0	18.0	17.0	10.0	12.5	10.0	1.9	1.8	1.7	13.5	14.0	13.0
BFI	105.5	105.7	105.4												
BDI	114.3	114.6	114.2												
BRI	120.5	121.1	120.2												
BI	12.9*	13.3	12.5												
HSI	41.4	41.3	41.5												
SSDI	54.0	54.4	53.8												

II: *Evaluation Pearson's correlation*

	WHc	BH	CH	TBH	SH	CD	CW	CW	FWP	WHt	CC	HL	TL	LL	PL	SCPL	SLPL	FLPL	LSB	ABL	SLFL	FLFL
WHc	+																					
BH	0.991	+																				
CH	0.972	0.972	+																			
TBH	0.915	0.917	0.936	+																		
SH	0.921	0.920	0.869	0.843	+																	
CD	0.861	0.845	0.872	0.789	0.596	+																
CW	0.570	0.542	0.515	0.452	0.492	0.534	+															
CW	0.429	0.417	0.442	0.424	0.259	0.548	0.589	+														
FWP	0.618	0.611	0.606	0.515	0.466	0.668	0.751	0.745	+													
WHt	0.945	0.936	0.932	0.866	0.834	0.862	0.637	0.530	0.695	+												
CC	0.730	0.737	0.754	0.719	0.545	0.795	0.689	0.782	0.807	0.824	+											
HL	0.326	0.310	0.330	0.295	0.344	0.224	0.479	0.373	0.505	0.307	0.242	+										
TL	0.760	0.763	0.794	0.720	0.641	0.732	0.654	0.626	0.743	0.817	0.814	0.465	+									
LL	0.578	0.573	0.601	0.682	0.443	0.615	0.574	0.451	0.480	0.599	0.632	0.400	0.635	+								
PL	0.508	0.495	0.524	0.477	0.370	0.567	0.484	0.615	0.658	0.556	0.672	0.345	0.663	0.398	+							
SCPL	0.834	0.829	0.797	0.765	0.738	0.758	0.616	0.448	0.528	0.836	0.729	0.078	0.638	0.547	0.479	+						
SLPL	0.579	0.569	0.553	0.493	0.546	0.483	0.660	0.404	0.533	0.607	0.498	0.284	0.540	0.394	0.425	0.621	+					
FLPL	0.542	0.540	0.549	0.475	0.532	0.424	0.317	0.293	0.375	0.551	0.386	0.395	0.436	0.457	0.237	0.491	0.539	+				
LSB	0.773	0.770	0.780	0.686	0.674	0.715	0.638	0.505	0.641	0.779	0.642	0.379	0.699	0.543	0.448	0.700	0.620	0.497	+			
ABL	0.650	0.646	0.622	0.612	0.614	0.540	0.338	0.223	0.355	0.623	0.334	0.351	0.438	0.500	0.293	0.530	0.574	0.564	0.537	+		
SLFL	0.512	0.501	0.494	0.391	0.449	0.470	0.374	0.389	0.500	0.480	0.446	0.463	0.535	0.435	0.466	0.359	0.392	0.442	0.477	0.379	+	
FLFL	0.659	0.645	0.642	0.548	0.672	0.482	0.351	0.154	0.351	0.653	0.350	0.474	0.454	0.345	0.313	0.457	0.537	0.677	0.540	0.559	0.524	+
SCFL	0.870	0.859	0.830	0.767	0.779	0.779	0.615	0.386	0.526	0.893	0.728	0.064	0.650	0.521	0.428	0.906	0.592	0.473	0.671	0.603	0.385	0.570

dimorphism in donkeys, we have still found it in strength of shin of both limbs and also in the above mentioned measurements.

When testing the measurements with Pearson's correlation, a positive correlation has been found in all of them. Also, a tight linkage has been found between WH and all other measurements. Therefore, it can be assumed that this value has certain influence on other measurements.

The research is still ongoing; obtaining values from other donkey individuals will equip us with more information about donkey population in the Czech Republic. Donkey breeding in the Czech Republic is a dynamic process, which allows us to acquire new data and contacts.

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