Bulgarian Journal of Agricultural Science, 18 (No 6) 2012, 971-979
Agricultural Academy

CRANIOLOGICAL CHARACTERISTICS OF WILD BOARS FROM THE REGION OF SARNENA SREDNA GORA MOUNTAIN, BULGARIA

V. DOYCHEV[1*], E. RAYCHEV[1] and D. KOSTOV[2]
[1] *Trakia University, Faculty of Agriculture, BG - 6000 Stara Zagora, Bulgaria*
[2] *Trakia University, Faculty of Veterinary Medicine, BG - 6000 Stara Zagora, Bulgaria*

Abstract

DOYCHEV, V., E. RAYCHEV and D. KOSTOV, 2012. Craniological characteristics of wild boars from the region of Sarnena Sredna Gora Mountain, Bulgaria. *Bulg. J. Agric. Sci.,* 18: 971-979

Craniological analysis of 18 male wild boar skulls has been conducted at completed growth (fully-grown third molar tooth). 44 craniological measurements have been made characterizing both the basic skull shapes and proportions (length, height, width and profile line), and the shape and proportions of the various skull parts (facial and cerebral) and of the various bones (lacrimal, palatal, etc.). The values found have been compared to the ones obtained by other authors. Based on the values found a classification analysis has been made to establish the population appurtenance of wild boars inhabiting in the region of Sarnena Sredna Gora Mountain.

It has been found out that male boars from the region of Sarnena Sredna Gora Mountain have an extended, relatively narrow and low skull, with a straight profile line. The lacrimal bone is extended, with a trapezoid shape. Concerning their craniological characteristics, male wild boars from the region of Sarnena Sredna Gora Mountain are attributed to the wild boar population inhabiting North Bulgaria. The basic skull dimensions characterizing its length, height and width are in positive correlation.

Key words: wild boars, craniology, lacrimal bone, palatal bone, correlations

Introduction

Due to the high adaptive abilities of the representatives of the swine (Suidae) family, they are widespread all over the world. Their natural habitat of occurrence comprising the continents Europe, Asia and Africa is significantly expanded through their introduction in North America, South America and Australia because of the human economic activity. According to Oliver et al., (1993) the species Sus Scrofa is the most numerous representative of suborder Non-ruminants (Suiformes) and the most widely spread species of the Swine (Suidae) family. Authors define the natural habitat of occurrence of the species as a region bordering Northwest Africa (Morocco) to the west, through the British Isles to the southern parts of the Scandinavian Peninsula. The north border begins at the southern parts of the Scandinavian Peninsula, passes to the north of the Baykal Lake and reaches the mouth of the Usuriyska river and the Japanese islands. The east border of the habitat is from Japan on the north to the islands of Sumatra and Java on the south. The south border starts from Morocco on the west, passes through the Mediterranean, Asia Minor and the Indochinese peninsula and reaches the islands of Sumatra and Java on the east. Because of its vast habitat of occurrence, the Sus Scrofa species comprises numerous subspecies, about the number of which there is certain contradiction among specialists. According to Genov (1999) the opinions of various authors concerning the number of subspecies

**E-mail: v.doichev@gmail.com*

in the Sus scrofa species are as follows: Ellerman and Morrison-Scott (1951) list 22 subspecies; according to Geptner et al.,(1961) there are 24 subspecies of the Sus Scrofa species; Epstein (1971) increased their number to 26, and Groves (1981) limited it to 15, moreover he included a new subspecies (Sus scrofa davidi) and mentioned the possible existence of more non-described subspecies, ten years later Mayer and Brisbin (1991) described 23 subspecies.

According to Genov (1999), the taxonomic problems related to determining the exact number of subspecies to the Sus scrofa species and defining the subspecies appurtenance of some specimens is accounted for by the following main reasons:

1. The vast habitat of occurrence and the lack of sufficient taxonomic data resulting in the initial description of numerous species, some of which were later defined as subspecies.
2. On the Malayan archipelago the subspecies Sus scrofa vittatus is widespread both in a wild and domesticated form. Very often, there are crossbreds both between these two forms and between them and the other species of wild boars inhabiting the archipelago (Sus celebensis, Sus papuensis and Sus verucosus).
3. In many regions around the world, including Bulgaria, various domestic breeds of swine are reared freely, on pastures and sometimes crossbreeding between them and the wild boar populations takes place.
4. In many countries in order to restore the number of wild boar populations, introduction and reintroduction of specimens from various Sus scrofa subspecies not typical of the respective habitats has been performed manifold.

According to the predominant part of authors, craniological measurements are one of the main classical methods for taxonomic definition of subspecies belonging to the Sus scrofa species.

Genov et al. (1991) carried out a large-scale craniological study of wild boars in Bulgaria, in which the skulls of 109 animals from the regions of Dobrudzha, Stara planina, the Rila-Rhodope range and Strandzha were included. The authors drew the conclusion that concerning craniological measurements, two populations are well distinguished – northern, comprising Dobrudzha and Stara planina mountain, and southern, comprising the Rila-Rhodope mountain range and Strandzha. It has been pointed out that the differences between the regions of Dobrudzha and the Rila-Rhodope range are very well manifested, which could be accepted as nuclei of the two populations – northern and southern, respectively. Although not very well manifested, difference in the north – south direction exists between the regions of Stara planina and Strandzha Mountain. At the same time, authors do not include in their study animals from the Sredna Gora Mountain, which is interesting from the point of view of its geographic location. Sredna Gora is in South Bulgaria, and on the other hand, it is close to Stara Planina Mountain, which is considered part of the northern wild boar population. The adjacency of both regions presupposes frequent genetic contacts of wild boars inhabiting them and respectively morphological proximity between them.

The objective of the present study was to analyze the craniological peculiarities of male wild boars from the region of Sarnena Sredna Gora Mountain.

Material and Methods

The skulls of 18 male wild boars, all in completed growth – fully grown third molar (M3) were used as material for the present study. All animals were shot as hunting trophies in Sarnena Sredna Gora Mountain in the region of Kavakliyka lodge on the west, to the passage between the village of Assenovets and Zhrebchevo dam on the east. The skulls have been prepared for measurement by routine methods including removal of hide, boiling, removal of the other soft tissues and degreasing of the skull in chloroform. By means of calipers with an accuracy of 1 mm, the following measurements have been made (Table 1):

The scheme of making the measurements is shown on Figures 1 – 4. The sizes of canine teeth were measured by the methods for evaluation of hunting trophies according to CIC (Ninov, 2004).

The population appurtenance of animals was determined by classification equations for the cranium proposed by Genov et al. (1991).

The results of the study have been statistically processed by the Statistica for Windows software, Release, 4.3 (Stat. Soft. Inc., 1994)

Table 1
Craniological measurements

No	Measurements	X	Sx	CV
1	Total length	42.59	1.84	3.40
2	Basal length	37.01	1.43	2.06
3	Facial length	32.01	1.81	3.26
4	Length of nasal bones (without processus nasalis.)	18.80	0.97	0.95
5	Length of nasal bones (with processus nasalis)	22.49	1.91	3.63
6	Inner skull diameter (longitudinal)	11.17	0.92	0.85
7	Outer skull diameter (transverse)	18.43	0.83	0.68
8	Length of lacrimal bone (upper)	6.09	0.60	0.36
9	Length of lacrimal bone (lower)	4.24	0.51	0.26
10	Length of lacrimal bone (rear)	2.49	0.25	0.06
11	Length of lacrimal bone (front)	3.20	0.48	0.23
12	Cheekbone width	15.39	0.76	0.57
13	Interorbital width	9.37	1.21	1.46
14	Palatal width behind canines	4.70	0.38	0.14
15	Palatal width behind 3rd molar tooth	4.37	0.32	0.10
16	Palatal width behind 4th premolar tooth	4.10	0.37	0.14
17	Depth of occipital area	1.68	0.30	0.09
18	Head skeleton angle	107.78	3.41	11.59
19	Lower jaw angle	105.56	3.70	13.67
20	Occipital area angle	96.28	3.91	15.27
21	Width of occipital area	8.22	0.61	0.38
22	Lower canine length	19.91	1.63	2.66
23	Lower canine width	2.43	0.16	0.03
24	Upper canine circumference	12.18	2.86	8.18
25	Lower jaw length up to process (proc. angularis)	29.75	1.23	1.52
26	Greatest lower jaw length	32.57	1.51	2.29
27	Inner width of mandible between canines	3.89	0.41	0.17
28	Width of mandible between condyles	8.07	0.57	0.33
29	Outer width of mandible behind canines	5.25	0.34	0.12
30	Outer width of mandible at condyles	14.10	0.66	0.44
31	Mandible height up to process	13.24	0.85	0.72
32	Mandible height behind canines	4.16	0.71	0.50
33	Skull height	22.65	2.03	4.11
34	Parietal length	5.54	0.35	0.18
35	Front length	13.17	0.61	0.65
36	Distance between inner processes hamuli pterigoidei	3.83	0.23	0.09
37	Length of paraoccipital processes	11.35	0.60	0.90
38	Height of occipital area	13.81	0.50	0.43
39	Distance between auditory nerve orifices	11.62	0.9	2.92
40	Condyle basal length	38.39	0.94	1.72
41	Length of intermaxillary suture	7.86	0.56	0.46
42	Palate width at third incisors	5.01	0.39	0.23
43	Maximum length of C1 alveoli	3.33	0.44	0.24
44	Distance between paraoccipital processes	6.71	0.29	0.43

Results and Discussion

Craniological measurements are presented in Table 1. Both from values of craniological measurements and in visual inspection (Figure 5) it has been established that the studied skull have shape typical for wild boars – long, with straight profile, relatively narrow and not high. Skull height comprises about 53% of its length. A number of authors note the elongated skull with low profile as typical for wild boars and they make a statement that the compact high skull is a morphological peculiarity that had occurred in the process of swine domestication (Knyazev and Tihonov, 1985; Tanchev et al., 1995). In a previous study of ours (Doichev et al., 2000), on craniological peculiarities of East Balkan swine we established a significantly more compact skull shape in this breed, the height comprising almost 70% of its length.

Concerning skull shape and proportions, the slope of the skull caudal facet is important. In the present study, we found mean value of the head skeleton angle 107.7°. Both from that value and from visual inspec-

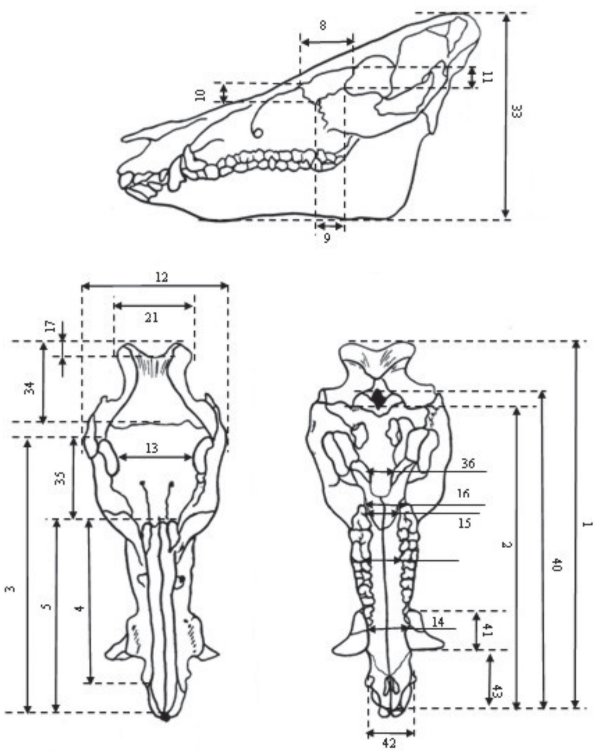

Fig. 1. Measurements of the lateral, dorsal and ventral facet of the head skeleton

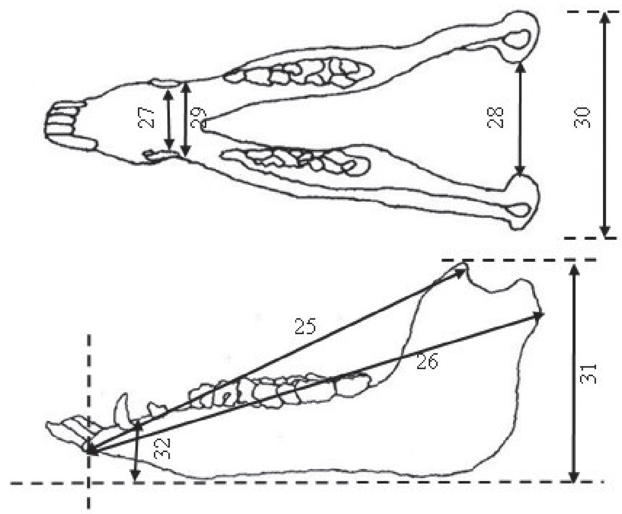

Fig. 3. Measurements of lower jaw

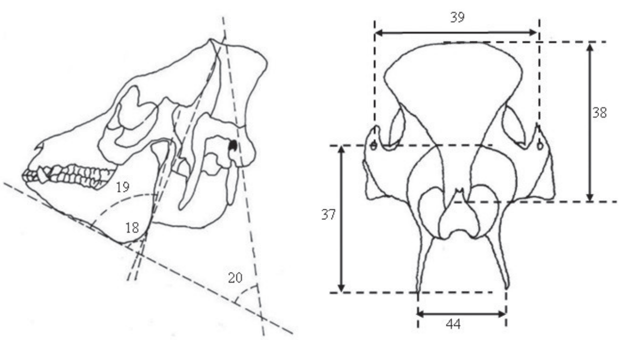

Fig. 2. Measurements of the caudal facet of the head skeleton

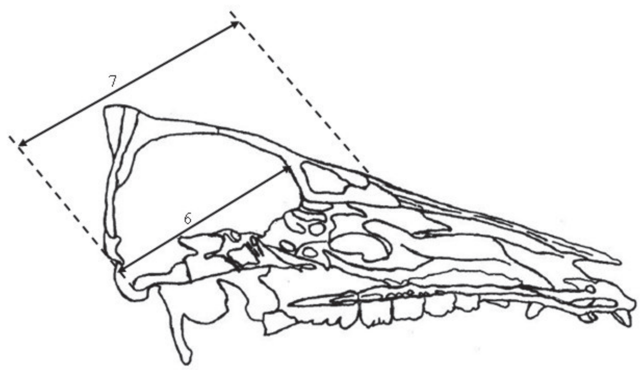

Fig. 4. Longitudinal diameter of skull (inner and outer)

tion (Figure 5) it is established that the caudal skull facet is tilted backwards. That correlates to the conclusions made by Knyazev and Tihonov, (1985), according to which the skull caudal facet in wild boars is tilted backwards, while in domestic swine it is vertical. In a previous study of ours on craniological peculiarities of East Balkan swine (Doichev at al., 2000) we found a smaller value of that angle – 100.39°.

An important craniological peculiarity is the shape and dimensions of the lacrimal bone (os lacrimale). A number of authors who had studied the craniological peculiarities in swine point out the shape and dimensions of lacrimal bone as one of the most reliable indicators for distinguishing various species of wild boars (Genov, 1999), of the eastern and western subspecies of Sus Scrofa (Filipchenko, 1933; Knyazev and Tiholov, 1985; Genov, 1999) and concerning the difference between present-day domestic swine, the wild predecessors and the different crossbreds between them (Petrov, 1973; Tanchev et al., 1995). It has been established visually (Figure 5), that the lacrimal bone is elongated in shape, and the values in table 1 show that the lower length of the facial facet (facies facialis) exceeds the height of the orbital facet (facies orbitalis) of the lacrimal bone by 1.7 times. Analyzing the craniological peculiarities of domestic and wild swine and the peculiarities of their inheritance in crossbreeding, Tanchev et al. (1995) established that the length of facial facet of the lacrimal bone in wild boars is about 1.5 times greater than the height of its orbital facet. As far as domestic swine are concerned, authors established that in them the lacrimal bone has a square-like shape. In a study of ours on the craniological peculiarities of East Balkan swine (Doichev et al., 2000) we found an almost square shape of the lacrimal bone and the lower length of the facial facet was almost equal to the height of its orbital facet. As far as the shape of the facial facet of the lacrimal bone is concerned, in the present study greater length

Fig. 5. Lateral, caudal and dorsal view of a wild boar skull

of the upper side of the facial facet was found compared to the lower side (6.09 / 4.24 cm), which gives trapezoid shape to the facial facet of the lacrimal bone. That corresponds to the shape of the facial facet of the lacrimal bone in the East Balkan swine and the wild boar established by Hlebarov (1921). Our results also correlate to these of Genov (1999). In a craniological study of wild boars (Sus Scrofa, L.) comprising 649 skulls from Europe, Asia and North Africa, the author distinguished four different shapes of the facial facet of the lacrimal bone, presented on Figure 6 (A). In addition to the well-known rectangular (1) and square (4), they also found a trapezoid (3) and a gun shape (2). The author makes the conclusion that in Europe and North Africa the most widespread shapes of lacrimal bone are the rectangular (1) and trapezoid (3). From all 18 skulls measured by us, 15 had trapezoid shape (3), one has a rectangular shape (1) and two had square shape (4). Obviously, in the skulls analyzed by us from the region of Sarnena Sredna Gora Mountain the trapezoid shape of the lacrimal bone is predominant.

In his study, Genov (1999) analyzed the shape of the caudal edge (margo liber) of the palatal bone and found the four shapes specified in Figure 6 (B). The 18 skulls measured by us are distributed as follows by shape of the rear edge of the palatal bone: (1) – 6 pcs.; (2) – 2 pcs.; (3) – 8 pcs. and (4) – 2 pcs. Obviously, in the skulls measured by us shapes 1 and 3 of the caudal edge of the palatal bone are prevalent. That corresponds to the conclusions made by Genov (1999), according to who shapes 1 and 3 of the caudal edge of the palatal bone are the most common in the wild boar populations in Europe.

As already pointed out, in a large-scale craniological study of wild boar populations dwelling on the territory of Bulgaria, Genov et al. (1991) measured a total of 109 skulls from the regions of Dobrudzha, Stara planina, Rila-Rhodope mountain range and Strandzha. Due to the discrimination analysis applied by them, authors define as well distinguished from each other concerning craniological peculiarities, two populations – north and south. Swine from the regions of Dobrudzha and Stara Planina belong to the north population. Animals from the Rila-Rhodope mountain range and Strandzha belong to the south population. Authors propose classification equations by means of which through the values of some craniological measurements the population appurtenance of each skull could be defined. The classification is done by calculating the equations for the north (N) and south (S) population for each skull. The skull is assigned to the north population (N) if the value obtained for (N) is higher and vice versa, it is assigned to the south population (S) if the value obtained for (S) is higher.

Applying the classification equations proposed by Genov et al. (1991), for the cranium, for all 18 skulls, we obtained higher values from the equation for the north population (Table 2). The mean value obtained for the north population is 362.62, and for the south one – 207.01. Based on that we define the 18 skulls studied by us as belonging to the north population of wild boars.

Regardless of the fact that from a geographic point of view Sarnena Sredna Gora Mountain is in South Bulgaria, it is in close proximity to Stara Planina Mountain separated from it by the relatively small Sub-Balkan valley. The Tundzha River crossing the Sub-Balkan valley is not a serious water obstacle. All that facilitates contacts between populations of wild boars dwelling in Stara Planina and Sarnena Sredna Gora

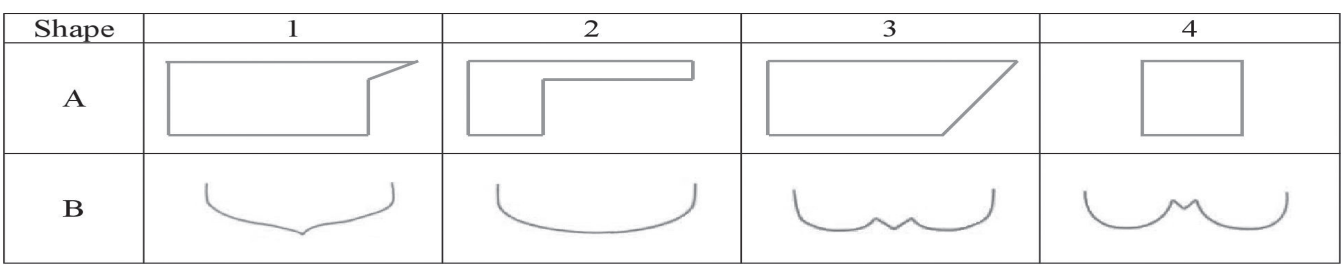

Fig. 6. Shape of lacrimal bone (A) and of the hind edge of the palatal bone (B)

Mountain, which in turn accounts for the craniological appurtenance of wild boars from Sarnena Sredna Gora to the north population. On the other hand, Sarnena Sredna Gora Mountain can be said to be isolated from the nucleus of the south population of wild boars located in the Rila-Rhodope Mountain range by the vast Thracian plain, which has areas that are more open and arable lands, considerably urbanized, crossed by the Maritsa river abounding in water and numerous transport routes. All that significantly hinders and makes the contact between wild boars from Sarnena Sredna Gora Mountain, on one hand, and the south population (the Rila-Rhodope Mountain range and Strandzha), on the other, almost impossible.

In this sense, Ihtiman Sredna Gora Mountain is interesting since it is a kind of a "green bridge" between Stara Planina and the Rila-Rhodope Mountain range, significantly facilitating the contacts between the wild boars from the north and south populations.

In Table 3, the correlations between some craniological measurements are shown. We establish high and very high correlation of the total skull length with the other basic measurements concerning length (basal length, length of nasal bones with and without processus nasalis, length of mandible up to the process (proc. angularis) and greatest mandible length). This is logical from the point of view of the fact that above lengths are more or less interrelated, and some of them largely comprise part of the overall skull length. Apart from that, considerable positive correlation of the total skull length is observed with some basic measurements characterizing its width (width between eye sockets and cheekbone width) and high, positive correlation with some measurements characterizing skull height (skull height, height of occipital area and height of mandible up to the process). As a whole from the data in Table 3, it is seen that the basic measurements characterizing length, width and height of skull are in positive correlation between each other. In our opinion that should be interpreted as an available mechanism for uniform growth of skull with animal growth and preservation of its main proportions. That corresponds to the statement of authors studying swine craniology (Knyazev and Tihonov, 1985; Tanchev et al., 1995), according to which the more compact, higher and wider skull of domestic swine distinguishing it from the wild ones, is a morphological peculiarity that had gradually evolved in the process of swine domestication. That peculiarity results from the long selection carried out by man in the process of formation and improvement of swine breeds. Probably we should take into account here the fact that in the process of breed formation in Europe swine from the Asian breeds have been used characterized by a short, high and wide skull, with a broken profile line.

The authors that study swine craniology point out the great importance of shape and sizes of lacrimal bone (os lacrimale), both for the species distinction of the various wild boar swine (Genov, 1999), and for distinguishing the numerous subspecies within the Sus Scrofa species (Filipchenko, 1933; Knyazev and Tihonov, 1985; Genov, 1999). Basic attention is paid to the lower length of the facial facet (facies facialis) and the orbital height (margo orbitalis) of the lacrimal bone and the correlation between them is calculated. The data in Table 3 show that the lower length of the facial facet of the lacrimal bone is in positive correlation (significant)

Table 2
Classification values for North / South population defining of the skulls

Scull No	N	S
1	389.33	243.41
2	724.42	549.84
3	42.38	-71.10
4	-222.10	-295.06
5	866.26	684.46
6	365.09	213.28
7	497.01	342.11
8	-4.42	-111.81
9	122.86	-7.13
10	102.72	-26.94
11	225.63	99.24
12	419.06	266.57
13	495.07	195.01
14	239.00	95.87
15	1433.82	1150.16
16	91.74	-26.57
17	268.02	131.88
18	471.30	294.50

Table 3
Correlations between some craniological measurements

Craniological measurements	Total length	Basal length	Skill height	Cheekbone width	Interorbital width	Head skeleton angle	Length of lacrimal bone (upper)	Length of lacrimal bone (lower)	Length of lacrimal bone (rear)	Length of lacrimal bone (front)	Length of lower canines	Width of lower canines	Circumference of upper canines
Total length		0.91	0.67		0.56			0.52				0.79	-0.42
Basal length	0.91		0.71		0.47							0.73	-0.42
Facial length	0.67			0.57	0.57		0.51			0.46		0.52	
Length of nasal bones (without processus nasalis.)	0.78	0.82						0.41				0.61	-0.44
Length of nasal bones (with processus nasalis)	0.78	0.86	0.64					0.45				0.58	
Inner skull diameter (longitudinal)													-0.62
Outer skull diameter (transverse)						-0.53		0.67	-0.49		-0.7		-0.67
Length of lacrimal bone (upper)				0.77	0.77					0.69			-0.38
Length of lacrimal bone (lower)					0.48		0.56		-0.43		-0.38		
Length of lacrimal bone (rear)			-0.42					-0.43		0.43			
Length of lacrimal bone (front)			-0.1		0.41		0.68						
Cheekbone width	0.59		0.6						-0.66			0.84	-0.50
Interorbital width	0.56						0.77		-0.50			0.64	
Palatal width behind canines				0.62								0.76	-0.56
Palatal width behind 3rd molar tooth					0.43								
Palatal width behind 4th premolar tooth					0.58							0.51	
Head skeleton angle			-0.30										
Lower jaw angle			-0.36			0.74							0.63
Occipital area angle			-0.40										
Width of occipital area										0.41	0.61		0.53
Lower canine width	0.79	0.79	0.72	0.84							0.53		0.59
Upper canine circumference	-0.42	-0.42	-0.50	-0.44								-0.60	
Mandible length, up to process	0.91	0.84	0.56		0.58			0.56				0.74	
Greatest mandible length	0.75	0.70	0.67					0.51				0.69	
Width of mandible (between condyles)									-0.35			0.41	
Width of mandible at condyles (outer)				0.77	0.49				-0.44			0.72	
Height of mandible (up to process)	0.70	0.72	0.86		0.53			0.58				0.62	
Height of mandible (behind canines)					0.64								
Skull height	0.67	0.71			0.46							0.72	
Parietal length									-0.57				
Front length												0.68	
Distance between inner processes hamuli pterigoidei				0.58	0.63				-0.47			0.56	
Length of paraoccipital processes	0.63							0.53	-0.52			0.63	
Height of occipital area	0.62				0.56			0.55				0.55	
Distance between auditory nerve orifices											0.63	0.52	0.47
Condyle basal length	0.89				0.43							0.69	
Length of intermaxillary suture													
Palate width at third incisors					-0.46	-0.57							
Distance between the tips of paraoccipital processes			-0.51	-0.72					0.50			-0.56	

with some of the measurements characterizing the length and height of skull: total skull length, length of nasal bones with and without processus nasalis; outer, longitudinal skull diameter; length of lower jaw to the process, biggest length of the lower jaw; height of lower jaw to the process; length of jugular processes and height of occipital area. At the same time we report significant negative correlation between the lower length of the facial facet of the lacrimal bone and its orbital height (margo orbitalis). In its turn, the orbital height of the lacrimal bone is in negative correlation (significant to high) with great part of the skull dimensions: upper length of the lacrimal bone; cheekbone width; width of the palatal bone behind canines; outer width of mandible at the condyles (proc. condylaris); parietal length; distance between inner processes hamuli pterygoidei; length of jugular processes and distance between the tips of jugular processes (proc. jugularis).

The interest in skulls of male wild boars has been provoked largely by the fact that by their greater dimensions and mostly because of their bigger canines they are attractive hunting trophies.

In relation to that, the correlation coefficients between the sizes of canines and craniological dimensions are of interest. From the data in table 3 it is seen that the width of the lower canines is in positive correlation (significant, high, to very high) with great number of the skull dimensions responsible for its length, width and height. A negative correlation is observed only with circumference of upper canine and the distance between the tips of jugular processes. The interesting fact is that the circumference of upper canines is in negative correlation (significant to high) with great number of the skull dimensions responsible for its length and width. We cannot find an explanation about that and we think that the clarification of the reason about these negative correlations needs further studies of animal skulls from both sexes dwelling in different regions and belonging to different age groups.

Conclusions

Based on the results obtained we can draw the following conclusions:

Male wild boars from the region of Sarnena Sredna Gora Mountain have elongated not very high and comparatively narrow skull with straight profile line. The lacrimal bone is elongated, with a trapezoid shape. Male wild boars from the region of Sarnena Sredna Gora Mountain, by their craniological peculiarities, shall be assigned to the north population of wild boars in Bulgaria. The basic skull dimensions responsible for its length, width and height are in positive correlation.

References

Genov, P., H. Nikolov, G. Massei and G. Gerasimov, 1991. Craniometrical analysis of Bulgarian wild boars. *Journal of Zoology,* **225:** 309 – 325.

Genov, P. V., 1999. A review of the cranial characteristics of the Wild Boar (Sus Scrofa Linaeus 1758), with systematic conclusions. *Mammal Review*, **29** (4): 205 – 238.

Doichev, V., V. Byalkov, S. Gadzhev, V. Katzarov, S. Tanchev and B. Szostak, 2000. Morphometrical analysis of skull of native East Balkan pig. *Animal Science Papers and Reports*, **18** (3): 183 – 194.

Filipchenko, Y. A., 1933. Craniological Study of Wild Boar Species. In: Problems of the Origin of Domestic Animals, editor-in-chief N. I. Vavilov rev. 7, 14 – 17, Academy of Sciences USSR, Moscow, (Ru).

Hlebarov, G. S., 1921. East Balkan Swine. Bulgarian Agrarian Society, Sofia (Bg).

Knyazev, S. and V. Tihonov, 1985. Cryological Peculiarities of European and Asian Wild Boars and Their Hybrids with Domestic Swine. In: Morphology and Genetics of Wild Boars. (editor-in-chief L.V. Davletova), Moscow, *Nauka,* pp. 33 – 49 (Ru).

Ninov, N., 2004. Hunting Trophies and Their Assessment. *Balkans.* Sofia, Bulgaria.

Oliver, W., L. Brisbin and S. Takahashi, 1993. The Eurasian wild pig (Sus Scrofa). In: Pigs, Peccaries and Hoppos, pp. 112 – 120. IUCN/SSC, Gland, Switzerland.

Tanchev, S., V. Katsarov, V. Doychev and S. Gadzhev, 1995. Craniological study of wild and domestic pigs and their hybrids. *Animal Sciences*, (5-8): 160 – 162 (Bg).

Received April, 2, 2012; accepted for printing September, 2, 2012.