Craniological variation of the Balkan chamois, Rupicapra rupicapra balcanica from Bulgaria

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Craniological variation of the Balkan chamois, *Rupicapra rupicapra balcanica* from Bulgaria

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Abstract. The craniometrical analysis of population diversity of the Balkan chamois (*Rupicapra rupicapra balcanica*) from Bulgaria was carried out using 14 skull parameters and 65 adult individuals, originating from the main occurrence areas in the country – Stara Planina, Rhodope, Rila and Pirin Mountains. The data showed a high degree of sexual dimorphism of the skull. The univariate and multivariate statistical assessment of the skull features of Bulgarian chamois, performed separately by gender, demonstrated a high degree of phenotypic craniological similarity between the specimens of the same gender from the four main populations in Bulgaria; it also supported the hypothesis that the present segregation of Bulgarian chamois into the four main mountains characterized by distinctive orographic features did not give rise to measurable levels of their craniometric differentiation.

Key words: skull features, craniometry, sexual dimorphism, population variety

Introduction

As shown by historical evidence, the chamois (*R. rupicapra*) is autochthonous in the territory of present Bulgaria, and nowadays it occurs in small numbers only in some parts of the mountain ranges of Rila, Pirin, Rhodopes and Stara Planina (Fig. 1a), where it inhabits rocky and difficult of access mountainous habitats, situated at 500-2900 m a.s.l. (Markov 1959, Spiridonov et al. 2011).

The information obtained by the Executive Forest Agency of Ministry of Agriculture and Foods of R. Bulgaria (AEFA 1994, 2006) about the chamois' numbers in the last decades of the 20th century and the beginning of the 21st century, showed stabilization in the species numbers at an average value of 1700 individuals all over country (Fig. 1b). A large part of natural chamois populations (ANSMB 2007) inhabit the National Parks, established in 1990s in Stara Planina (≈ 144 individuals), Rila (≈ 236 individuals) and Pirin (≈ 259 individuals), the ranges of which are under increased protection; only the population in Rhodope (≈ 503 individuals) is subjected to hunting under special regulations.

For several years, craniometric data and horn metric features of chamois were evaluated from the territory of Bulgaria (Massei et al. 1994, Massei et al. 1997, Markov et al. 1998). The compiled data reported the metrical characteristics of the skulls and horns of an aggregated group of chamois, formed by animals from the entire country (for details see Markov 2010). However, no information has ever been reported about skull shape variation and horn features of the animals from the extant chamois populations in Bulgaria, which are well differentiated geographically and probably the connection between some of them was interrupted about 100 years ago.

The lack of knowledge about the craniological differentiation of geographically isolated chamois populations in Bulgaria determined the aims of this paper as follows: i) to analyse the extent of sexual dimorphism in skull size features of the chamois at a local population level; ii) to review their population geographic variation; and iii) to determine the interpopulation specific relationships in skull characters of Bulgarian chamois in the biggest part of its range in the country.

Material and Methods

A total of 65 adult individuals (38 males and 27 females) of the Bulgarian chamois from four populations, from the individual mountain ranges (Fig. 1) were included in the analyses, namely: Stara

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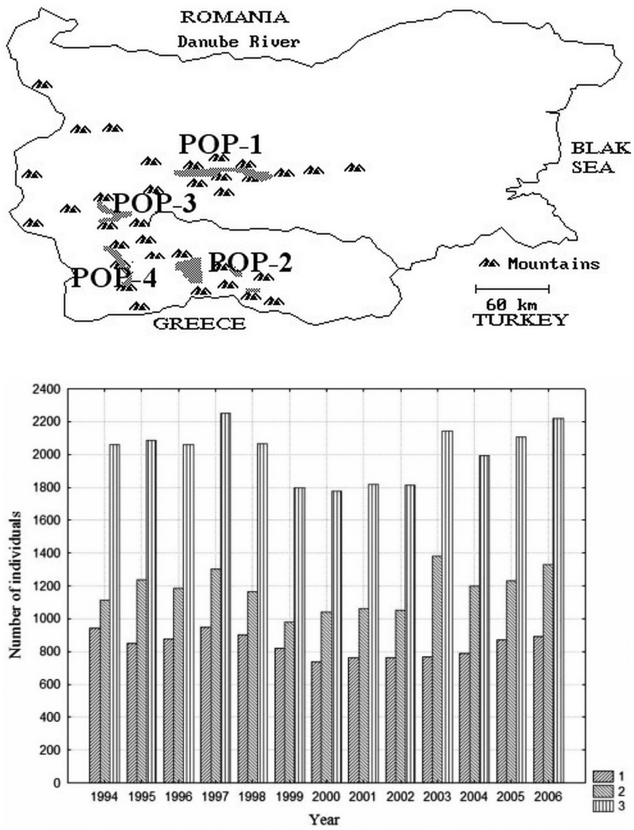

Fig. 1. Main areas of the occurrence of chamois (a) in Bulgaria: Stara Planina Mountain (POP-1), Rhodope Mountains (POP-2), Rila Mountain (POP-3) and Pirin Mountain (POP-4); and absolute numbers (b) of the chamois during the period 1994-2006: (1) – in protected park territories, (2) – partly protected park territories and (3) – all over the territory of Bulgaria.

Planina (total number of investigated specimens – 18; 10 males and 8 females), Rhodope (20; 14 males and 6 females), Rila (14; 7 males and 7 females) and Pirin (13; 7 males and 6 females).

The analysed sample consisted of specimens kept in the scientific collections of public institutes such as Natural History Museum (Sofia), Forestry University (Sofia), trophy collection of different hunting enterprises in the country, but the biggest part of them (about 75 %) belonged to private collections.

The craniological description of chamois from Bulgaria and the examination of their degree of similarity and differentiation was based on fourteen skull and dental measurements taken with a digital calliper with an accuracy of 0.01 mm according to the compiled set of craniometrical parameters used in the morphological studies of chamois by Hrabě & Koubek (1983), Couturier (1938) and Fernandez-Lopez & Garcia-Gonzalez (1986) (Table 1).

Age determination was based on the counting the horn annuli (Schröder & Elsner-Schack 1985). Only individuals older than four years, whose skulls growth has terminated (Lovari & Scala 1980, Hrabě & Koubek 1982), were included into the examination. Data were tested for normality using Kolmogorov-Smirnov D-statistics, and for homogeneity of variances using Levene's test. The basic statistical parameters: the mean (X), the standard deviation (SD), the standard error of the mean (SE) and the ± 95 % confidence interval of the mean values were calculated for all investigated morphometric characteristics of each investigated groups of animals.

First, to assess the effect of sex on inter-sample variation, an analysis of variance (ANOVA) was performed on the whole data set. Discriminant function analysis was used to determine which variables discriminate sexual dimorphism between the specimens of the both sexes. Sexual dimorphism within each population, for every single craniometrical parameter, was further analysed by Student t-test for independent samples by groups with "sex" as grouping variable.

Table 1. The skull characters studied in Bulgarian chamois (*R. r. balcanica*).

	Character	
K1	Total length of skull	Maximum distance between acrocranion and prosthion
K2	Condylobasal length	Maximum distance between prosthion and the point in which the line connecting the most aboral points of occipitalcondyli cuts the median plane
K3	Basal length	Maximum distance between basion and prosthion
K4	Length of nasal part of skull	Maximum distance between caudal margin of nasalia and prosthion
K5	Length of neurocranium	Distance between acrocranion and nasalia
K6	Length of nasalia	Maximum length
K7	Length of upper tooth row	Distance between anterior margin of alveolus of P^1 and the posterior one of M^3
K8	Diameter of orbit	Vertical diameter
K9	Diameter of orbit	Horizontal diameter
K10	Maximum width of neurocranium	Distance between the most lateral points of the brain case (euryons)
K11	Biorbital width of skull	Maximum distance between the most lateral points on the orbits (ectoorbitals)
K12	Infraorbital width of skull	Measured in the narrowest place between the orbits
K13	Maxillary width	Width between the oral ends of the facial edge
K14	Width of nasalia	Maximum width

The examination of the craniometric diversity of the specimens from the four geographic populations from Bulgaria included the following steps:

(i) Craniometric variation between the specimens from the four geographic populations was evaluated for each sex by one-way ANOVA;

(ii) The factor analytic techniques (factor analysis, extraction method – principal components; factor rotation – Varimax normalized) were used to characterize the multidimensional craniometrical diversity of the chamois specimens of both sexes from investigated populations by: 1) reducing the number of variables and 2) detecting the structure in the relationships between variables, that is to classify variables;

(iii) For each sex, phenetic relationships between geographic populations were determined by cluster analyses joining (tree clustering), using single linkage and Euclidean distance matrix;

(iv) To assess the geographic population differentiation of chamois from Stara Planina, Rhodope, Rila and Pirin Mountains, separately by gender, a discriminant analysis (stepwise discriminant function analysis with model definition – forward stepwise) was run on the skull characters of all population. All calculations were performed using the statistical package STATISTICA 2008 version 8.0 (StatSoft Inc. 2008).

Results

The analysis of variance (one-way ANOVA) applied to test for significant differences between the means of the studied 14 cranial parameters of both genders of chamois in the combined group of specimens from four populations showed an effective hypothesis decomposition (effect: sex, Wilks' lambda: 0.278, F: 6.493, effect df: 14, error df: 35, p = 0.000*) or significant difference between the means.

Applying a T-test for independent samples by groups with „sex" as grouping variable, a detailed evaluation of the differences between all means in these two groups was obtained. Significant differences were found in 71.43 % of all studied characters (p = 0.05) and the means were higher in males (Table 2).

The factor analysis revealed three factors explaining the biggest part of the variation of the studied group of chamois of both sexes from Bulgaria – 72.14 %. In the first factor the highest values belonged to five craniological characters describing the skull lengths (from K1 to K4 and K6); the highest values in the second factor belonged to two characters related width the dimensions (K13 and K14) and in the third factor – to two characters assessing to the orbit diameters (K8 and K9). Grouped in this way, the differing characters of the both sexes revealed a complete craniometrical differentiation of chamois skull toward a well expressed sexual dimorphism.

The multivariate analysis of sexual craniometrical differences in Bulgarian chamois (stepwise analysis) resulted in 10 variables combined in statistically significant discriminant functions (Wilks' lambda: 0.287, approx. F (10, 39) = 9.663, p < 0.0000), which discriminated the skulls of Bulgarian chamois between the both sexes (Y male = 17.49 K14 + 11.98 K7 + 12.00 K2 + 25.54 K8 – 1.09 K5 + 7.62 K11 + 29.79 K9 + 11.04 K10 – 7.53 K3 + 6.03 K13 – 2992.20 and Y female = 15.98 K14 + 11.11 K7 +11.16 K2 + 26.48

Table 2. The number of specimens (N), mean length (X), standard deviation (SD), standard error (SE) and t-test: t-value (T), degrees of freedom (df), p-value (p), difference between the mean values of females and males (Fe-Ma) and confidence intervals of the mean (± 95 % Confid.), separately for each craniometric parameter in both sexes of chamois (*R. r. balcanica*) in Bulgaria. Symbols of the characters are the same as in Table 1.

	Male				Female				Differences between the mean values of the craniometric parameters					
Var.	N	X	SD	SE	N	X	SD	SE	T	df	p	Fe-Ma	–95 %	+95 %
K1	23	213.90	5.12	0.977	33	207.47	5.61	1.068	–4.37	54	0.0001	–6.43	–9.38	–3.48
K2	23	202.72	5.43	0.925	31	196.83	5.15	1.132	–4.06	52	0.0002	–5.89	–8.80	–2.98
K3	21	188.76	6.20	0.917	29	182.19	4.94	1.354	–4.17	48	0.0001	–6.56	–9.73	–3.40
K4	24	119.22	5.02	0.966	34	114.96	5.63	1.025	–2.97	56	0.0044	–4.26	–7.14	–1.38
K5	25	107.57	3.76	0.639	35	106.68	3.78	0.752	–0.89	58	0.3757	–0.88	–2.86	1.10
K6	24	64.98	3.47	0.895	36	60.81	5.37	0.709	–3.36	58	0.0014	–4.17	–6.65	–1.69
K7	26	58.71	3.07	0.452	36	58.22	2.71	0.603	–0.67	60	0.5075	–0.49	–1.97	0.98
K8	27	38.66	0.71	0.147	38	39.04	0.91	0.136	1.82	63	0.0740	0.38	–0.04	0.80
K9	27	36.57	0.85	0.165	37	37.06	1.00	0.164	2.04	62	0.0454	0.49	0.01	0.96
K10	26	63.00	2.27	0.297	38	61.73	1.83	0.446	–2.46	62	0.0169	–1.26	–2.29	–0.23
K11	27	108.77	2.94	0.578	38	105.33	3.56	0.566	–4.11	63	0.0001	–3.44	–5.11	–1.77
K12	27	75.36	4.14	0.432	38	73.34	2.66	0.797	–2.39	63	0.0198	–2.02	–3.70	–0.33
K13	26	64.85	2.55	0.350	37	64.31	2.13	0.501	–0.91	61	0.3670	–0.54	–1.72	0.65
K14	24	21.65	1.16	0.260	36	19.58	1.56	0.237	–5.54	58	0.0000	–2.07	–2.81	–1.32

Table 3. Population descriptive statistics: number of specimens (N), mean length (X), standard deviation (SD), standard error (SE) of the craniometric parameter (Var.) and confidence intervals of its mean length (±95 %), separately for each craniometric parameter in the both sexes (male – M, female – F) of chamois (*R. r. balcanica*) in the main localities in Bulgaria: Stara Planina (POP-1), Rhodope (POP-2), Rila (POP-3) and Pirin (POP-4). Characters are the same as in Table 1.

Var.	Sex	N	X	SD	SE	–95 % Confid.	+95 % Confid.	Var.	Sex	N	X	SD	SE	–95 % Confid.	+95 % Confid.
Population 1								Population 2							
K1	M	10	215.66	6.18	1.95	211.24	220.08	K1	M	8	215.75	5.98	2.11	210.75	220.75
	F	8	206.03	3.72	1.31	202.92	209.13		F	3	206.80	10.53	6.08	180.65	232.95
K2	M	10	204.97	4.94	1.56	201.44	208.50	K2	M	8	204.48	6.85	2.42	198.74	210.21
	F	8	194.58	4.48	1.58	190.83	198.32		F	3	195.33	9.91	5.72	170.71	219.95
K3	M	10	190.91	5.13	1.62	187.24	194.58	K3	M	8	190.20	5.87	2.07	185.30	195.10
	F	8	180.64	4.90	1.73	176.54	184.74		F	3	180.20	10.82	6.24	153.33	207.07
K4	M	10	120.01	5.86	1.85	115.81	124.21	K4	M	8	120.23	6.84	2.42	114.51	125.94
	F	8	113.39	3.04	1.08	110.85	115.93		F	3	114.87	6.66	3.84	98.33	131.41
K5	M	10	108.95	3.06	0.97	106.76	111.14	K5	M	8	110.25	4.16	1.47	106.77	113.73
	F	8	105.86	3.02	1.07	103.34	108.39		F	3	108.47	9.17	5.29	85.70	131.24
K6	M	10	64.69	5.96	1.88	60.43	68.95	K6	M	8	64.01	6.23	2.20	58.80	69.22
	F	8	59.76	2.73	0.97	57.48	62.05		F	3	60.33	3.11	1.79	52.62	68.05
K7	M	10	58.52	2.67	0.84	56.61	60.43	K7	M	8	58.51	2.58	0.91	56.35	60.67
	F	8	59.41	3.47	1.23	56.51	62.31		F	3	57.17	3.13	1.80	49.40	64.93
K8	M	10	38.69	0.84	0.27	38.09	39.29	K8	M	8	38.51	0.95	0.34	37.72	39.31
	F	8	38.90	0.55	0.19	38.44	39.36		F	3	39.30	1.13	0.65	36.50	42.10
K9	M	10	36.60	1.02	0.32	35.87	37.33	K9	M	8	36.06	0.95	0.34	35.26	36.86
	F	8	37.09	0.55	0.19	36.63	37.54		F	3	37.00	0.53	0.31	35.69	38.31
K10	M	10	63.30	1.77	0.56	62.03	64.57	K10	M	8	63.50	1.29	0.46	62.42	64.58
	F	8	61.10	2.27	0.80	59.20	63.00		F	3	62.80	0.36	0.21	61.90	63.70
K11	M	10	109.52	1.79	0.57	108.24	110.80	K11	M	8	107.35	2.42	0.86	105.33	109.37
	F	8	104.06	2.69	0.95	101.82	106.31		F	3	105.77	3.87	2.23	96.16	115.38
K12	M	10	75.25	2.31	0.73	73.60	76.90	K12	M	8	74.90	2.33	0.83	72.95	76.85
	F	8	72.61	4.31	1.52	69.01	76.21		F	3	69.73	4.50	2.60	58.56	80.90
K13	M	10	65.01	1.86	0.59	63.68	66.34	K13	M	8	65.41	2.18	0.77	63.59	67.24
	F	8	64.20	3.15	1.12	61.56	66.84		F	3	63.27	1.62	0.93	59.25	67.28
K14	M	10	22.00	0.80	0.25	21.43	22.57	K14	M	8	21.10	1.47	0.52	19.87	22.33
	F	8	19.27	0.68	0.24	18.71	19.84		F	3	19.70	1.90	1.10	14.98	24.42
Population 3								Population 4							
K1	M	6	211.27	3.85	1.57	207.23	215.30	K1	M	5	212.68	4.09	1.83	207.60	217.76
	F	6	209.87	4.76	1.94	204.87	214.86		F	4	205.57	3.41	1.70	200.15	211.00
K2	M	6	200.10	2.22	0.91	197.77	202.43	K2	M	5	201.04	1.71	0.77	198.91	203.17
	F	6	199.17	4.82	1.97	194.10	204.23		F	4	195.95	3.04	1.52	191.11	200.79
K3	M	6	185.40	2.62	1.07	182.65	188.15	K3	M	5	186.16	1.17	0.52	184.71	187.61
	F	6	184.52	4.99	2.04	179.28	189.75		F	4	183.30	7.62	3.81	171.17	195.43
K4	M	6	116.93	5.79	2.37	110.85	123.01	K4	M	5	117.40	5.18	2.32	110.97	123.83
	F	6	115.38	5.25	2.14	109.87	120.89		F	4	111.70	2.10	1.05	108.35	115.05
K5	M	6	105.88	2.43	0.99	103.33	108.43	K5	M	5	106.74	1.61	0.72	104.74	108.74
	F	6	107.17	2.07	0.84	105.00	109.34		F	4	105.88	3.31	1.66	100.60	111.15
K6	M	6	63.28	4.48	1.83	58.58	67.98	K6	M	5	65.20	3.52	1.57	60.83	69.57
	F	6	61.97	3.91	1.60	57.86	66.07		F	4	59.27	3.86	1.93	53.13	65.42
K7	M	6	58.52	3.81	1.56	54.52	62.52	K7	M	5	60.28	1.27	0.57	58.70	61.86
	F	6	58.07	3.09	1.26	54.82	61.31		F	4	58.45	1.93	0.97	55.37	61.53
K8	M	6	38.42	1.03	0.42	37.34	39.50	K8	M	5	39.14	0.86	0.38	38.08	40.20
	F	6	38.95	0.48	0.20	38.45	39.45		F	4	39.67	0.13	0.06	39.47	39.88
K9	M	6	36.55	0.67	0.27	35.85	37.25	K9	M	5	37.14	0.78	0.35	36.18	38.10
	F	6	37.10	0.37	0.15	36.71	37.49		F	4	37.25	0.34	0.17	36.71	37.79
K10	M	6	62.50	1.89	0.77	60.51	64.49	K10	M	5	62.52	2.01	0.90	60.02	65.02
	F	6	60.53	2.43	0.99	57.98	63.08		F	4	61.15	2.44	1.22	57.27	65.03
K11	M	6	108.55	3.49	1.42	104.89	112.21	K11	M	5	109.40	2.02	0.90	106.89	111.91
	F	6	106.50	3.58	1.46	102.74	110.26		F	4	106.25	1.40	0.70	104.02	108.48
K12	M	6	75.08	2.65	1.08	72.31	77.86	K12	M	5	75.72	3.55	1.59	71.32	80.12
	F	6	75.63	2.84	1.16	72.65	78.62		F	4	72.88	4.24	2.12	66.13	79.62
K13	M	6	64.15	1.15	0.47	62.94	65.36	K13	M	5	64.96	2.94	1.31	61.31	68.61
	F	6	65.05	3.04	1.24	61.86	68.24		F	4	63.80	2.70	1.35	59.51	68.09
K14	M	6	21.65	1.35	0.55	20.23	23.07	K14	M	5	21.74	1.00	0.45	20.50	22.98
	F	6	19.15	0.90	0.37	18.20	20.10		F	4	19.88	1.61	0.80	17.32	22.43

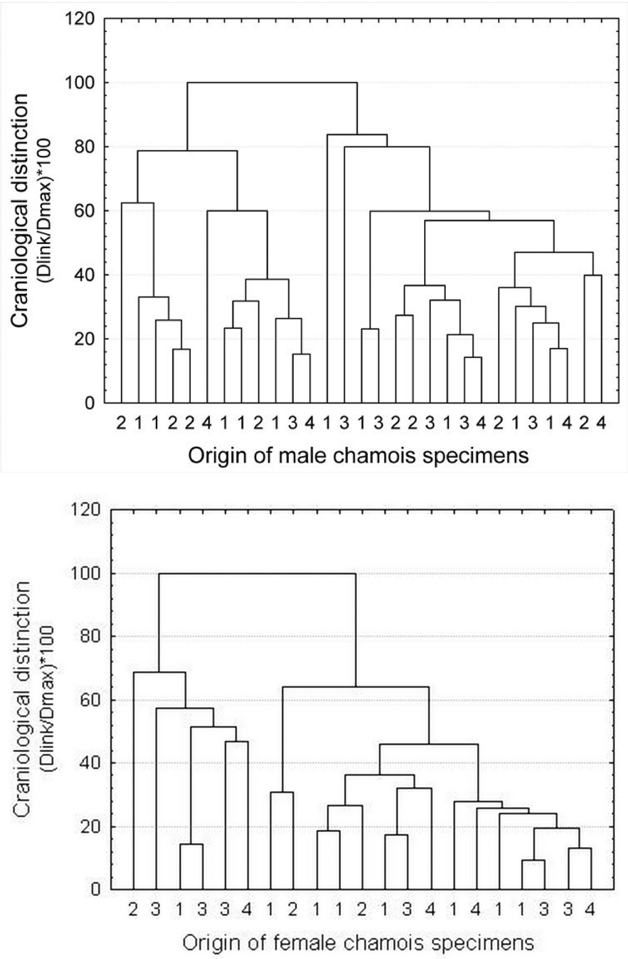

Fig. 2. Phenotypic craniological distinction of the males (a) and females (b) individuals from the four main mountain ranges with the occurrence of chamois (*R. r. balcanica*) in Bulgaria. 1: Stara Planina, 2: Rhodope, 3: Rila, 4: Pirin.

K8 – 0.64 K5 + 7.25 K11 + 32.07 K9 + 10.40 K10 – 6.84 K3 + 5.25 K13 – 2901.58) and the total correct distribution of the studied specimens was 94 %.

The extended analysis of the sexual dimorphism in skull size, carried out in the four studied populations of Bulgarian chamois showed that it was strongly expressed in all of them (Table 3); thus, the craniometric characters should be analyzed separately.

The multivariate population analysis of sexual craniometric differences in each separate population resulted in craniometric discriminant functions, which determine correctly with high statistical significance ($p < 0.05$) the sex of the studied specimens. In the populations from Rhodope (POP-2), Rila (POP-3) and Pirin Mountains (POP-4) 100 % of the studied specimens were determined correctly. In the Stara Planina population (POP-1) the total correct differentiation was 94.7 %; correct differentiation of the females was 100 % and correct differentiation of the males was 99.90 %.

In the classification functions for craniometric determination of the sex in chamois from its main localities in Bulgariain in various combinations are included 10 of all 14 investigated skull features. Discrimination functions for the sex determination of chamois from the Stara Planina population (POP-1) contain the skull features K14, K11, K12 and K5 and for population of Rhodope (POP-2) parameters K9, K12, K7, K5, K6, K4, K1 and K14. The craniometrical determination of the sex in chamois from the other two main populations includes only two skull features – for the population of Rila (POP-3) they are K14 and K5, and for the population of Pirin (POP-4) they are K2 and K7.

The examination of phenetic craniometric differentiation of the males from the four geographic populations by one-way ANOVA for significant differences between the means of the studied 14 cranial parameters showed that the effective hypothesis could not be decomposed at $p = 0.05$ (effect: population; Wilks' lambda: 0.008; F: 1.101; effect df: 42; error df: 36, 36; $p = 0.386$) or the differences between the means were statistically insignificant.

The female chamois from the four populations also demonstrated a high degree of phenotypic craniological likeness. One-way ANOVA for significant differences ($p = 0.05$) between the means of the studied 14 cranial parameters of the females showed that the effective hypothesis could not be decomposed at $p = 0.05$ (effect: population; Wilks' lambda: 0.006; F: 1.411; effect df: 42; error df: 12, 63; $p = 0.259$) or the differences between the means were statistically insignificant.

The high degree of phenotypic craniological similarity both between males and between females from the four populations was also revealed by the multivariate estimation of their skull features and was manifested by the results of the cluster analysis (Fig. 2).

The grouping of males (Fig. 2a) into clusters according their craniometric similarity was not bound to the geographic origin. This connection was very weak in all loosely formed clusters which joined together specimens from different populations. The estimation of the relative craniometric similarity of the females did not reveal as well any connection between the formed clusters and the geographic origin of the studied populations. The females manifested relatively higher degree of craniometric differentiation and the formed clusters (Fig. 2b) had very low degree of similarity and they also joined together specimens from different populations.

The multivariate population analysis of the craniometric differences between males (stepwise analysis, Wilks'

Lambda = 0.482, approx. F (9, 56) = 2.182, $p < 0.0371$) was not able to determine correctly the studied specimens according to the populations they came from. The total correct distribution was only 51.43 % and the lowest percentage of correct determination was found in the specimens from Pirin – only 33.33 %. The percentage of correct determination of the males from the other studied populations was also low.

The multivariate estimation of the degree of interpopulation craniological differentiation of the studied females (stepwise analysis, Wilks' Lambda = 0.032, approx. F (30, 24) = 1.794, $p < 0.0727$) was 85.71 % but at level of significance $p = 0.0727$, which differs from the accepted in such investigations level of $p = 0.05$.

Discussion

In the present study the analysis of skull features allowed to assess the similarities of main chamois populations from Bulgaria.

All the results obtained during the study of the sexual cranial dimorphism of the chamois in Bulgaria were consistent with the previous morphological investigations of this species. They expanded and added details to the knowledge about the well expressed craniometrical differentiation of both the sexes in Bulgaria, requiring future analyzes aiming to detect and assess the degree of craniometrical similarity and distinction of chamois to be carried out separately by gender.

The univariate and the multivariate estimation of the skull features of the males and females revealed high degree of phenotypic craniological similarity between the specimens of the same gender from the main four populations of the species in Bulgaria; in multivariate aspect that was more pronounced in males.

In general, the results of the comparative population analysis of the craniometric parameters of chamois from Bulgaria support the hypothesis, that the present separation of the Bulgarian chamois into the four main mountains characterized by distinctive orographic features did not give rise to measurable levels of their craniometric differentiation. They are in line with the view that the metric parameters of such structure of vital importance as cranium are conservative and change their characteristics slowly (Yablokov 1987).

As a result of prolonged isolation of individual populations and fragmentation of the range of chamois in Bulgaria with the absence of natural corridors connecting the main mountains, small and isolated populations have been formed; probably, intensive inbreeding took place there. The relatively low population numbers of the Balkan chamois in its main areas of occurrence in the country initiated efforts to intensify the conservation of this species.

The chamois had already obtained legal protection – in Bulgaria, the Balkan chamois is protected by both European and National legislation, listed in the Annexes II and IV of the Habitat Directive (Council of Europe 1992), Annex 3 to art. 37 of the Biodiversity Act and was included in the Red Data Book of the Republic of Bulgaria (Golemansky 2011) as endangered species. This measure is important for the conservation of the species, but it should be combined with future population morphological and genetic studies of Bulgarian chamois focused on its current phenotype and genetic diversity. Thus, the obtained information about the phenotypic characteristics of the Balkan chamois from its main occurrence areas in Bulgaria became a part of the necessary knowledge about the population phenotype geographic differentiation of this subspecies which facilitates the development of the integral picture of the subspecies taxonomic structure of *R. rupicapra* in South-eastern Europe.

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