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MICROGEOGRAPHICAL NON-METRICAL CRANIAL DIVERSITY OF THE FAT DORMOUSE (*Glis glis* L.)

Georgy Georgiev MARKOV

ABSTRACT. Variability of 12 non-metric traits was studied on skulls of 103 individuals of the Fat dormouse (*Glis glis* L) from Vitosha Mountains, Rhodope Mountains and four populations located in the Mountain system of Stara planina in Bulgaria. The epigenetic variability of these 6 groups of *Glis glis* is similar in the studied populations. The lack of clearly outlined epigenetic differentiation between the Fat dormouse populations in Bulgaria showed that the occurrence of non-metric variants cannot serve as an unequivocal basis for the assignment of a particular individual to a concrete geographic population. Nevertheless, the frequencies of occurrence of non-metric variants in population samples may provide information on directional tendency of the epigenetic population structure of the species in its main habitats in the Stara planina Mountain system, where the populations express the microgeographic epigenetic fragmentation of the Fat dormouse in Bulgaria.

Key words: Epigenetic variability, Fat Dormouse, *Glis glis*, microgeographic differentiation.

YEDİUYURLARDA (*Glis glis* L.) MİKROCOĞRAFİ NON-METRİK KRANİAL ÇEŞİTLİLİK

ÖZET. Bulgaristan'ın Stara planina Dağ sistemlerindeki dört lokalite ile Rodop Dağları ve Vitoşa Dağlarından elde edilen 103 Yediuyura (*Glis glis* L) ait kafataslarında 12 non-metrik özelliğin değişkenliği araştırılmıştır. *Glis glis*'in bu 6 grubunda epigenetik değişkenlik incelenen populasyonlarda benzerdir. Bulgaristan'daki Yediuyur populasyonları arasında çok belirgin bir epigenetik farklılaşmanın bulunmaması, bu populasyonlarda mevcut non-metrik varyantların da bir bireyin hangi coğrafi populasyona ait olduğunu değerlendirmeye de yardım edemeyeceğini gösterir. Bununla birlikte, populasyon örneklerinde non-metrik varyantların mevcut sıklıkları bu türün asıl habitatlarını içeren ve populasyonlarının mikrocoğrafi epigenetik parçalanmalar gösterdiği Stara planina Dağ sisteminde epigenetik populasyon yapısının yönsel eğilimi hakkında bilgiler verebilir.

Anahtar sözcükler: Epigenetik değişkenlik, Yediuyur, *Glis glis*, mikrocoğrafi farklılaşma.

INTRODUCTION

The Fat dormouse (*Glis glis* L) is spread all over Bulgaria, occurring mainly in deciduous woodlands in which the dominant tree species are oak, beech, walnut and other fruit-trees (1). These woodlands are situated in all the main Bulgarian Mountains and the Fat dormouse inhabits biotopes, which are quite variable in view of their ecological conditions.

In contrast to the relatively well known distribution of the Fat dormouse in the country, the epigenetic characteristics of its populations and the differentation in habitats with diverse ecological conditions were unknown to date. This determined the goal of the present study: to find the frequencies of the cranial non-metric characters, on the basis of which to determine the epigenetic variability and the mean measure of divergence between the Fat dormouse populations from its main habitats in the country and to analyze their mutual geographical epigenetic relations.

MATERIAL AND METHODS

Variability of non-metric traits was studied on skulls of 103 individuals of Fat dormouse from six Bulgarian populations. Four of them are located in the mountain system of Stara planina: 1 - West Stara

Institute of Zoolog, 1 Tzar Osvoboditel, 1000 Sofia, Bulgaria. E-mail: Geomar@datacom.bg

planina (30 specimens), 2 - Central Balkan (11 specimens), 3 - East Stara planina (12 specimens) and 4 - West Fore-Balkan (20 specimens). The remaining two populations originate from 5 -Vitosha mountain (25 specimens) and 6 - Rhodope (5 specimens) mountains (Fig.1) characterized (2) by a great variety of ecological conditions and strongly expressed differentiation of the horizontal and vertical distribution of the physical geographic components.

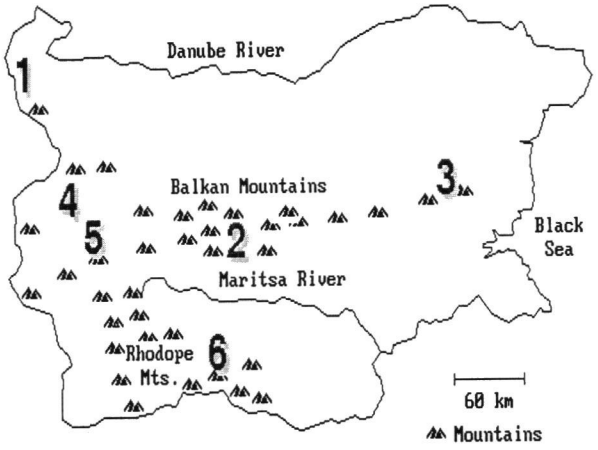

Fig. 1. Geographic situation of the epigenetically studied populations of the Fat dormouse (*Glis glis* L.) from Bulgaria: 1 - West Stara planina 2 - Central Balkan, 3- East Stara planina, 4- West Fore-Balkan, 5-Vitosha Mountain, 6 - Rhodope Mountain

The appearance of 12 cranial traits representing orifices of nerves and blood vessels was recorded. These traits were chosen from the ones used by Berry (3), Berry and Searle (4) and Hedges (5) for rodents and were deduced from the left side of the skull. Their status was recorded as follows: 1. Fenestra flocculy - present; 2. Preorbital foramen - double; 3. Anterior frontal foramen - present; 4. Posterior frontal foramen - present; 5. Maxillary foramen I - present; 6. Maxillary foramen I - present; 7. Foramen sphenoidale medim - present; 8. Processus pterygoideus - present; 9. Foramen ovale - double; 10. Foramen hypoglossi - double; 11. Foramen basioccipitale - present; 12. Foramen mental - double.

The apparent absence of sexual dimorphism and age dependence in the expression of the studied traits permitted pooling the male and female individuals of each particular population in a common sample.
On the grounds of the established frequency distribution of the 12 epigenetic traits examined the epigenetic variability (V) and the measure of uniqueness (MU) were computed for each one of the 6 examined populations as well as the mean measure of divergence (MMD) between each single population and all the others. The statistical analysis of the epigenetic diversity and differentiation between the six Fat dormouse populations was carried out using the methods proposed by Berry (4), (6), Sjovold (7) and Smith (8).

RESULTS

The frequency distribution of the non-metric traits within the main populations of the Fat dormouse in Bulgaria, is shown in Table1. There is no trait expressing null frequency simultaneously in all the studied populations.

The trait "Foramen ovale - double" shows the highest degree of expression in 66.7% of the populations studied. The poorest expression was found for the trait "Processus pterygoideus - present " with null value in 83.3% of the populations.

Most of the traits exhibiting polymorphous statements were revealed in the West Stara planina and Vitosha populations. Only 16.7% of the traits in these populations had null expression. The highest number of traits with null expression (41.7%) was found in the Fat dormouse populations from Rhodope mountain and Central Balkan.

Table 1. Frequency distribution of the nonmetric craniological traits within populations of the Fat dormouse (*Glis glis* L.) from Bulgaria: 1 - West Stara planina 2 - Central Balkan, 3- East Stara planina, 4- West Fore-Balkan, 5-Vitosha Mountain, 6 - Rhodope Mountain.

	Populations					
No. traits	*1* *N = 30*	*2* *N = 11*	*3* *N = 12*	*4* *N = 20*	*5* *N = 25*	*6* *N = 7*
1	0.3200	0.4286	0.3333	0.3889	0.6000	0.5000
2	0.4444	0.8000	0.6364	0.5790	0.5600	0.8000
3	0.5000	0.3000	0.5455	0.1000	0.4400	0.6000
4	0.0769	0.1000	0.1000	0.0000	0.2000	0.0000
5	0.0000	0.0000	0.0000	0.0500	0.0000	0.2000
6	0.0333	0.0000	0.0000	0.0000	0.0400	0.0000
7	0.0333	0.0000	0.0000	0.0500	0.0417	0.0000
8	0.0000	0.0000	0.1111	0.0000	0.0000	0.0000
9	0.9643	0.8750	0.6667	0.2632	0.8750	0.5000
10	0.7143	0.6250	0.4444	0.6130	0.6000	0.7500
11	0.0357	0.0000	0.2000	0.0500	0.0800	0.0000
12	0.5333	0.6667	0.8182	0.2000	0.6400	0.8000

The Fat dormouse population from East Stara planina has the highest epigenetic variability, similar to the one from the Vitosha mountain population (Table 2).

The degree of epigenetic variability in the populations from West Stara planina and from Rhodope mountain were also similar, as well as in those from the Central Balkan and West Fore-Balkan.

The average value of the population epigenetic variability of Fat dormouse in Bulgaria calculated on the grounds of the 6 populations was 0.12005.

Table 2. Epigenetic variability (Vi), uniqueness (MU) and epigenetic distances (MMD) (the upper line), and their standard diversion (the lower line in italic) of the studied populations of the Fat dormouse (*Glis glis* L.) from Bulgaria: 1 - West Stara planina 2 - Central Balkan, 3 - East Stara planina, 4 - West Fore-Balkan, 5 - Vitosha Mountain, 6 - Rhodope Mountain. The epigenetic distances between the studied populations significant from statistical point of view are matched with the asterisk.

Popolation Numbers	2	3	4	5	6	MU	Vi
1	-0.0276 *non*	0.0830 *0.0609*	0.2660* *0.0916*	-0.0105 *non*	0.0802 *0.0830*	0.1632	0.1143
	2	-0.0241 *non*	0.1950 *0.1025*	-0.0501 *non*	-0.1238 *non*	-	0.1059
		3	0.2800* *0.1189*	0.0156 *0.0270*	-0.0442 *non*	-	0.1390
			4	0.3030* *0.0963*	0.0700 *0.0799*	0.9190	0.1084
				5	0.0471 *0.0642*	0.0270	0.1354
					6	-	0.1173

The East Stara planina and Vitosha populations manifested the highest relative population epigenetic variability with 16% and 13%, respectively higher than the species average epigenetic variability in Bulgaria. The other four populations had lower values but not sharply differing from the average for the country epigenetic variability (Fig. 2).

The highest epigenetic uniqueness, quite different from the other mountain populations of the Fat dormouse, was found in the West Fore-Balkan population.

The only statistically significant epigenetic distances among all those studied were between the population of West Fore Balkan and populations from Vitosha, West Stara planina and East Stara planina.

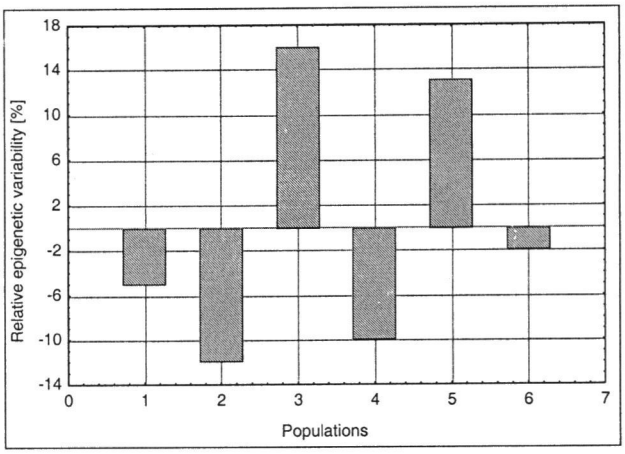

Fig. 2. Population epigenetic variability of the Fat dormise (Glis glis L.) from: 1 - West Stara planina 2 - Central Balkan, 3- East Stara planina, 4- West Fore-Balkan, 5-Vitosha Mountain, 6 - Rhodope Mountain, in relation to the average one for the species in Bulgaria

DISCUSSION

The distribution of non-metric characters shows, that all of them exhibit polymorphous expression in the epigenetic cranial characteristics of the Fat dormouse in Bulgaria.

The comparative analysis of relative epigenetic variability of Fat dormouse from its main habitats in the country revealed that the phenotypic diversity of the studied Bulgarian populations studied is not high. The occurrence of the frequencies of the studied non-metric characters could not be correlated with Fat dormouse habitats. High values of epigenetic variability of Fat dormouse populations were established in biotopes with different climatic factors – for example, East Stara planina, which has relatively mild climatic conditions, and Vitosha Mountain with its pronounced continental mountain climate. At the same time, the Fat dormouse populations manifesting the most similar low values of the populational epigenetic variability in the country differ by climatic conditions. One of them occurs in the sheer part of the Stara planina Mountain chain, while the other one inhabits the Stara planina foothills. The intra-population epigenetic distances in the Fat dormouse in Bulgaria demonstrate that the most differentiated is the West Fore-Balkan population originating from the only region among the studied ones, which does not comprise a real mountain ecosystem. This population exhibits the highest epigenetic uniqueness and the only statistically significant epigenetic distances to the populations from Vitosha, West Stara planina and East Stara planina.

The established epigenetic differentiation of the Bulgarian Fat dormouse populations and the relatively uniform epigenetic variability of the species in the territory of Bulgaria suggest that probably both the differences in the ecological conditions of their habitats and their geographic isolation have not reached the extent to provoke micro-evolution processes and result in subspecific differentiation of the Fat dormouse in Bulgaria, based on the epigenetic differentiation. The lack of clearly outlined epigenetic differentiation between the Fat dormouse populations in Bulgaria showed that the occurrence of non-metric variant cannot serve as an unequivocal basis for assingning of a particular individual to a concrete geographic population. Nevertheless, the frequencies of occurrence of non-metric variants in population samples may provide information on directional tendency of the epigenetic population structure of the

species in its main habitats in the Stara planina Mountain system, and to express the micro-geographic epigenetic fragmentation of the Fat dormouse in Bulgaria.

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