

**CRANIOLOGICAL CHARACTERIZATION OF WOOD MOUSE
(*APODEMUS SYLVATICUS*) – BIOLOGICAL INDICATOR
IN PARK ECOSYSTEMS**

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ABSTRACT. Frequency distribution of phenotype realization of discrete alternative craniological traits – markers of genotype structure of wood mouse (*Apodemus sylvaticus*) in populations inhabiting two park territories of Sofia under different human impact.

The phenotype specificity of morphogenetic variation of the natural populations of the studied zoomonitor was characterized, reflecting their specific values in the environment of park territories of Sofia.

The obtained characteristics of epigenetic polymorphism of studied craniological morphogenetic markers reveals the possibility to be applied as information parameter in biomonitoring of urbanized environment condition through the zoomonitor *A. sylvaticus* in the park territories of Sofia.

KEY WORDS. Wood mouse, *Apodemus sylvaticus*, non-metrical characteristics, zoomonitor, urban territories,

INTRODUCTION

The changes in natural environment caused by human impact have been subjected to different specialized studies. Within this wide range of approaches bioindication becomes of great importance in connection with the problem about assessment of the quality of natural environment in park ecosystems in urbanized territories – assessment of quality of environment and its characteristics by the condition of the biota, while changes in the environment are studied through the populations of species, which are the most sensitive to certain factors and react clearly to their changes.

The small mammals' populations inhabiting urbanized landscapes as a result of the process of „sin-urbanization“ differ by many parameters from the populations

inhabiting natural ecosystems (Andrzejewski et al., 1978). Among the small mammals included in the process of sin-urbanization a special attention should be paid to non-sinanthropic species, such as wood mice.

When condition of these populations is assessed with respect to the changes in the environment it is more and more necessary to apply multi-level approach in the study of processes of onto- and morphogenesis as bases of structural-functional and phenotypic specificity and stability of populations in territories modified by human activities.

In this respect, the results of one purely population method of biomonitoring, the phenetic analysis based on the analysis of morphogenetic variation of natural populations, become highly informative measures of the reaction of wild animals' populations to the appearance of new factors.

Because of their place in trophic chains the populations of murine rodents undertake directly the influence of one factor or another. Being an important component of natural ecosystems, they are widely used as model objects in investigations of urban environment conditions changing as a result of human activities.

Owing to their relatively high numbers, attachment to not very large territory, lifespan, high sensitivity to pollutants and possibility for extrapolation of the results of eco-toxicological analysis of small rodents to man, wood mouse presents itself as very adequate zoomonitor in the process of bioindication of park territories in urban agglomerations.

On the grounds of revealed frequency distribution of realized phenotypes of discrete alternative traits – markers of genotype structure, present investigation aims to establish the specific values of morphogenetic variation of the wood mouse (*Apodemus sylvaticus* Linnaeus, 1758) in populations inhabiting two park territories of Sofia under different degree of human impact and to analyze them comparatively.

MATERIAL AND METHODS

Comparative characterization of wood mouse individuals (*A. sylvaticus*) originating from the following localities was carried out: 1 – South Park, Sofia (650 m altitude, 1996-1997, 16 specimens); 2 – South Park, Sofia (2003-2004, 15 specimens); 3 – Vitosha Natural Park in the region of Simeonovo (780 m altitude, 15 specimens).

Species determination of caught individuals was carried out under laboratory conditions. After being skinned and cleaned, the skulls were prepared for the following morphological and epigenetic analysis. Phenogenetic analysis of the studied populations of wood mouse was carried out on 20 aberrations (phens) representing small discrete variations of the cranial structure.

The non-metric craniological variation was assessed on the grounds of the occurrence of these qualitative skull traits, which represent presence or absence of particular foramina for blood vessels or nerves, additional bone structures, etc. The

scheme of Hedges (1969) was applied. The traits were scored only on the left side of the skull under binocular microscope with magnification of 12x.

The epigenetic polymorphism and differentiation of the studied populations were statistically assessed by the methods proposed by Berry (1968), Sjøvold (1973) and Smith (1981). The epigenetic variation (Vi) and epigenetic uniqueness (MU) of each one population as well as the epigenetic distance (MMD) between all possible pairs of populations were calculated on the grounds of the observed frequencies of the studied traits.

RESULTS AND DISCUSSION

The frequency distribution of examined non-metric traits characterizing population epigenetic cranial polymorphism of the wood mouse in the studied park territories is presented in fig. 1. It is specific for each particular population. There are traits, which have not manifested any polymorphism and such revealing significant difference in frequency distribution with the other traits in every population.

Traits 3 – „parted frontals“, 4 – „fused frontals“ and 20 – „third molar missing“ had zero occurrences in the three compared wood mouse populations. Trait 1 – „preorbital foramen double“ and 18 – „accessory mental foramen“ were observed only in specimens from Sofia South Park (1996-1997), while in the other two populations they had zero occurrences. Incidences of traits 2 – „interfrontal present“ and 19 – „mandibular foramen double“ were typical for the wood mouse from Vitosha Natural Park in the region of Simeonovo as they were not found in the other two groups. The highest frequency revealed trait 17 – „foramen hypoglossi single“, which occurred in all studied individuals from Vitosha Natural Park.

Estimation of epigenetic variation of the studied populations of wood mouse in the park territories (fig. 2) showed the lowest value in 2 – Sofia South Park (2003-2004). The populations 1 – Sofia South Park (1996-1997) and 3 – Vitosha Natural Park (2003-2004) demonstrated similar variation (difference of only 1.3 %). The variation between population 1- Sofia South park (1996-1997) and 2 – Sofia South Park (2003-2004) was 13.9 % and between 2 – Sofia South Park (2003-2004) and 3 – Vitosha Natural Park (2003-2004) was 14.6 %. Thus, significant differences between the three groups were not found and they manifested similar pattern of variation.

At the same time all the calculated epigenetic distances were statistically insignificant ($p < 0.05$) (fig. 3) and epigenetic cranial uniqueness of any studied population was not found.

The results of comparative analysis of epigenetic variation, the absence of statistically significant interpopulation distances of the studied groups as well as the lack of epigenetic cranial uniqueness of any studied population from the three localities in the surveyed park territories distinctly showed that the investigated individuals from Vitosha Natural Park and the both temporary groups from Sofia South Park could be pooled together and the phenotypic specificity of the morphogenetic variation of natural populations of the zoomonitor wood mouse in park territories of Sofia could be characterized by the frequency distribution of the studied morphogenetic markers (fig. 4).

Through expanding of quantitative characterization of the frequency distribution of the phenotypes realized in non-metric craniological markers a possibility is revealed to include the epigenetic analysis by means of assessment of morphogenetic variation of the wood mouse (*Apodemus sylvaticus*) as a component of biological monitoring and especially in order to follow the changes in morphs ratio and appearance of new phenotype trends under the influence of natural and anthropogenic factors with the increased urbanization of the park territories in Sofia.

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REFERENCES

- ANDRZEJEWSKI, R., J. BABINSKA-WERKA, J. GLIWICZ, J. GOSZCZYNSKI. 1978. Synurbization processes in an urban population of *Apodemus agrarius*, I. Characteristics of population in urbanization gradient. *Acta theriologica* 23: 341-358.
- HEDGES, S. 1969. Epigenetic polymorphism in populations of *Apodemus sylvaticus* and *Apodemus flavicollis* (Rodentia, Muridae). *Journal of Zoology* 159: 425-442.
- BERRY, J. 1968. The biology of non-metrical variation in mice and men. Pp, 103-113, In: Brothwell D. (ed.): *The skeletal biology of earlier human populations*. London, Pergamon Press.
- SJOVOLD, T. 1973. The occurrence of minor, non-metrical variation in the skeleton and their quantitative treatment for population comparison. *Homo* 24: 204-233.
- SMITH, F. 1981. Relationships between genetic variability and niche dimensions among coexisting species of *Peromyscus*. *Journal of Mammalogy* 62(2): 273-285.

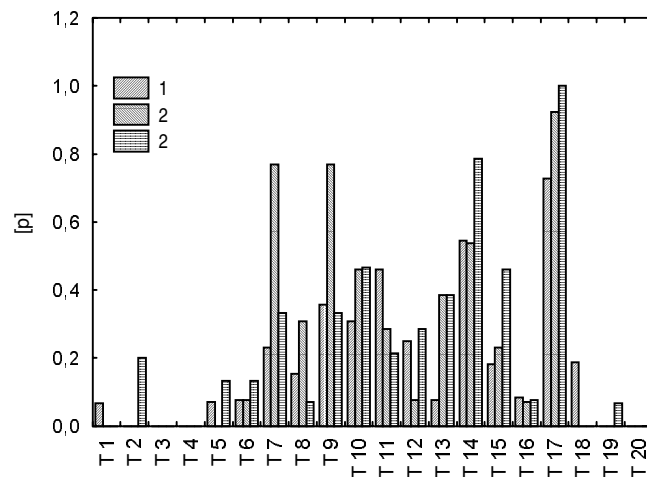


Fig. 1. Frequency distribution (p) of the studied non-metric cranial traits (No T1-T20) from: 1 – Sofia South Park (1996-1997); 2 – Sofia South Park (2003-2004); 3 – Vitosha Natural Park in the region of Simeonovo

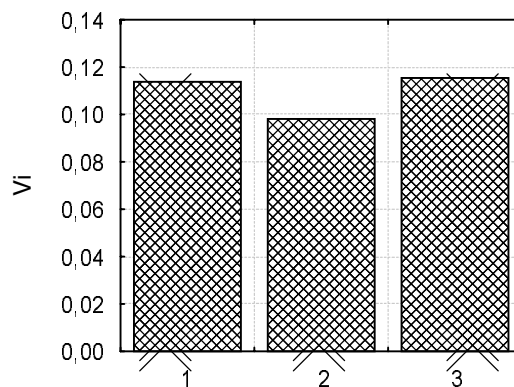


Fig. 2. Epigenetic variation (V_i) in the populations of wood mouse (*Apodemus sylvaticus*) from: 1 – Sofia South Park (1996-1997); 2 – Sofia South Park (2003-2004); 3 – Vitosha Natural Park in the region of Simeonovo

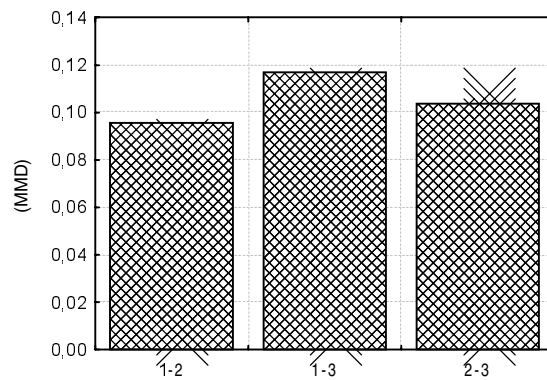


Fig. 3. Interpopulation (1-2; 1-3; 2-3) epigenetic distances (MMD) in wood mouse populations (*Apodemus sylvaticus*) from: 1 – Sofia South Park (1996-1997); 2 – Sofia South Park (2003-2004); 3 – Vitosha Natural Park in the region of Simeonovo

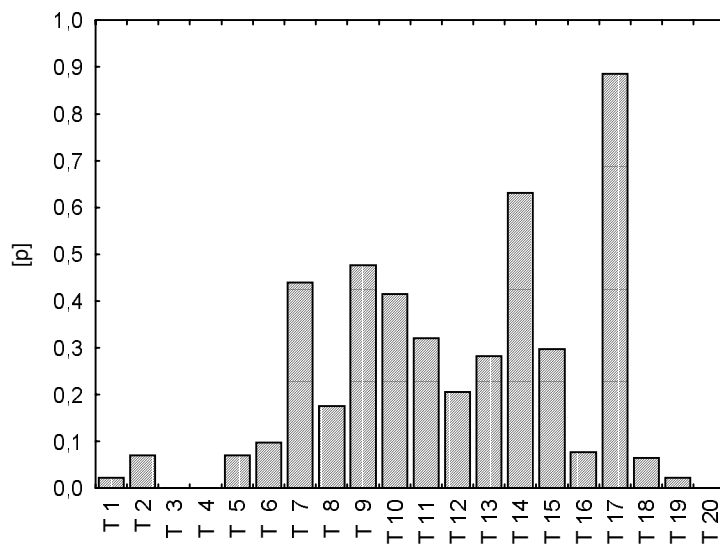


Fig. 4. Frequency distribution (p) of the studied non-metric cranial traits (No T1-T20) from park territories in the south part of Sofia