Molar Patterns in Microtus guentheri (Danford and Alston, 1880) (Mammalia: Rodentia) from Kırıkkale Province

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INTRODUCTION

One of the genera of the Arvicolinae subfamily, Microtus, is ecologically diverse and includes the widespread herbivorous mammals and is one of the most speciose genera in the Holarctic region, consisting of about 65 extant species resulting from a rapid adaptive radiation [1]. Microtus is distributed in meadows, rocky areas, open grasslands, pastures, forests, cultivated areas, taiga, tundra and dry steppe ecosystems of the northern hemisphere [1, 2, 3]. Boundaries and phylogenetic relationships in Microtus were interpreted basing on morphological and genetic arguments although these characters have not solved all question of the taxonomy of this genus yet. However, each species possessed its own characteristic molar enamel pattern [1].

One of the species of the genus, Guenther’s vole (Microtus guentheri), was firstly described from Kahramanmaraş by Danford and Alston [4] and is distributed in Turkey (except for the eastern Black Sea mountains), Greece, South-eastern Bulgaria, Southern Serbia, Macedonia, Israel, Syria, Lebanon, Libya, Northeastern Iraq and Northwestern Iran and on a few islands [5, 6, 7]. A group of Microtus voles, called as socialis group (M. guentheri, M. socialis, and M. irani) is characterized by certain morphological, cranial as well as karyological peculiarities [6, 8].

The aim of this study was to contribute to the molar morphotypes of Microtus guentheri distributed in Turkey, and make a comparison with the previous published data for the species.

MATERIAL AND METHODS

2.1. Study area: This study is conducted in the districts of Kırıkkale; Center (39° 50' N, 33° 30' E), Balışeyh (39° 48' N, 33° 26' E), Delice (39° 56' N, 34° 01' E), Keskin (39° 40' N, 33° 36' E), Yahşihan (39° 51' N, 33° 27' E), Balışeyh (39°54' N, 33° 43' E), Karakeçili (39° 35' N, 33° 22' E), Çelebi (39° 27' N, 33° 31' E), and Sulakyurt (40° 09' N, 33° 43' E).

A total of 89 voles (56 male, 31 female and two undetermined sex) captured between 2001 and 2003, were examined. The age of the specimens was determined according to the general characteristics (i.e. suture line of the nasal and frontal bone) of the skull and reproductive condition. Specimens were divided into two age groups: young and adults. Males and females were evaluated together.

The identification of the specimens were achieved according to the morphological (fur color, bicolour tail, tail length to head and body length) and karyological (2n=54, NF=54, NFe=52) characteristics as given by Gözütok and Albayrak [9]. The definitions of Corbet and Southern [10], Niethammer and Krapp [11], Moyer et al. [12] and Chaline and Graf [13] were used in teeth terminology. Drawings of upper and lower molars have been produced by using camera lucida attached to a binocular. Molar teeth were measured parallel to occlusal surface with a micrometer, accuracy of up to 0.01 mm, attached to the binocular. Maxillary and mandibulary toothrow lengths, lengths of M¹, M², M³, M⁴, and M⁵ were measured as maximum distances of occlusal surface. Box-plot diagram and histogram of the M³ measurements in young and adult specimens were performed using SPSS 15. Skins and skulls of the specimens are deposited in the Department of Biology, University of Kırıkkale.

RESULTS

We examined 17 (13 ♂♂, 3 ♀♀ and one undetermined sex) young and 72 (43 ♂♂, 28 ♀♀ and one undetermined sex) adult specimens of Microtus guentheri and determined individual variations both in upper and lower molar teeth.

Molar enamel patterns in the second upper molar teeth (M²) of the young specimens were all found to be non-agrestis morphotype according to Corbet and Southern
M2 of only one specimen of adults were found to be agrestis while the rest were non-agrestis morphotype (Fig. 1).

**Fig. 1.** Non-agrestis morphotype of M2 in young (A) and agrestis morphotype of M2 in adult (B) *Microtus guentheri* (Scale: 1mm)

Regarding the third upper molars (M3) of the young specimens, examined according to Niethammer and Krapp [11], 13 were normal, 2 were duplicate, and 2 were complex form. M3 of 30 adult specimens were normal, 37 duplicate, three complex, and two simplex (Fig. 2).

**Fig. 2.** Normal (A) and duplicate (B) forms of M3 in young, complex (C) and simplex (D) form in adult *Microtus guentheri* (Scale= 1mm)

All the first upper molars (M1) of youngs, examined according to Moyer et al. [12], possessed four closed triangles. Thirteen of the second upper molars (M2) possessed two closed triangles and areas 4 and 5 were confluent; and four of them possessed no closed triangle although areas 2, 3 and 4, 5 were confluent. The third upper molars (M3) of five specimens possessed three closed triangles, six had no closed triangle but areas 2, 3 and 4, 5 were confluent, and two had two closed triangles and areas 4, 5 were confluent. Only one specimen possessed one closed triangle and areas 2 and 3 were confluent. M1 of adult specimens also possessed four closed triangles. Sixynine of the M2 possessed two closed triangles, and areas 4 and 5 were confluent, two of them possessed no closed triangles, and areas 2, 3 and 4, 5 were confluent, and only one possessed four closed triangles. The M3 of 48 specimens possessed three closed triangles, 19 had one closed triangle, and areas 2 and 3 were confluent, three had no closed triangles but areas 2, 3 and 4, 5 were confluent, and only one had two closed triangles, and areas 4 and 5 were confluent (Fig. 3).
Fig. 3. Variability in the $M^2$ and $M^3$ of young and adult specimens of *Microtus guentheri*. Three closed triangles (A), no closed triangles, areas 2, 3 and 4, 5 confluent (B), two closed triangles, areas 4, 5 confluent (C), one closed triangle, areas 2 and 3 confluent (D) Two closed triangles, areas 4 and 5 confluent (E), no closed triangles, areas 2, 3 and 4, 5 confluent (F), four closed triangles (G), three closed triangles (H), one closed triangle, areas 2 and 3 confluent (I), no closed triangles, areas 2, 3 and 4, 5 confluent (J), two closed triangles, areas 4 and 5 confluent (K) (Scale= 1mm)
The $M^3$ of nine young specimens, examined according to Chaline and Graf [13] were complex and those of seven specimens were simplex. In addition, $M^3$ of 50 adult specimens were complex and 22 were simplex (Fig. 4).

Fig. 4. Complex (A) and simplex (B) forms of $M^3$ of adult *Microtus guentheri* (Scale= 1mm)

$M^1$ of all youngs and adults were arhombomorph type. Anteroconid complex was large and rounded in shape in all young and adult specimens and furthermore, no variation was determined in the shape of the anteroconid complex in both (Fig. 5).

Fig. 5. Arhombomorph type of $M^1$ in young (A) and adult specimen (B) of *Microtus guentheri* (Scale= 1mm)

In the young and adult specimens of *Microtus guentheri* five closed triangles, as stated by Bell and Bever [14] for the American species of the genus, were also determined in Turkish specimens.

Measurements of upper and lower molar teeth of young and adult *Microtus guentheri* specimens are given in table (Table 1).
Concerning the molar measurements of young and adult specimens, an overlap in size of $M_1$ was determined due to the largest youngs and smallest adult specimens existed in the samples (Fig. 6).

**Table 1.** Dental measurements (mm) of young and adult *Microtus guentheri* specimens from Kırıkkale province (N: number of sample, SD: Standard deviation)

<table>
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<th>Characteristics</th>
<th>YOUNG</th>
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<td>Mean</td>
<td>SD</td>
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<td>Range</td>
<td>Mean</td>
<td>SD</td>
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<td>C-M$^1$</td>
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<td>5.0-6.7</td>
<td>5.85</td>
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<td>68</td>
<td>6.2-8.2</td>
<td>7.07</td>
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<td>Length of $M_1$</td>
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Fig. 6. Box-plot diagram (A) and histogram (B) of $M_1$ comparison in young and adult specimens of *Microtus guentheri*
DISCUSSION

The genus *Microtus* is represented in Turkey, by *M. arvalis*, *M. socialis*, *M. daghestanicus*, *M. majori*, *M. subterraneus*, *M. guentheri*, *M. levis*, *M. dogramacii* and *M. anatolicus* [7]. Despite the different karyotypes (*M. guentheri* 2n=54, *M. socialis* 2n=62 and other members of the *socialis* group 2n=48 and 2n=60), morphology of the molar enamel pattern did not provide categorical differences between the four species of the *socialis* group [6].

Yiğit and Çolak [15] stated that *Microtus guentheri* did not penetrate into Central Anatolia due to the mountainous region therefore, the authors identified the specimens from Ankara and Kırıkkale as a new subspecies, *M. lydius ankaranensis*. However, Musser and Carleton [7] reported *M. lydius ankaranensis* as a synonym of *M. guentheri*.

Niethammer and Krapp [11] reported agrestis morphotype of *M. arvalis* from SE Anatolia and added that this morphotype was very rare in western Anatolia. With this study, we determined the agrestis morphotype only in one adult specimen. Furthermore, Ondrias [16] and Yiğit and Çolak [15] observed non-agrestis morphotype in *M. guentheri* and *M. lydius*. Non-agrestis form is the most determined form in Kırıkkale province.

Kefelioğlu [17] recorded that in *M. guentheri* specimens captured from Kahramanmaraş and Mersin and *M. guentheri lydius* from Antalya and İzmir, of the third upper molars 69% were normal, 23% simplex, and 0.08% duplicate. M³ were recorded as 85% normal and, 15% duplicate from Hatay, Kahramanmaraş, Kilis and Gaziantep as well as 85% were normal, 9% duplicate and 6% simplex from Ankara and Kırıkkale [15]. In our study, in adult specimens the third upper molar patterns were 48.6% duplicate, 41.6% normal, 4.16% complex, and 2.77% simplex. In contrast to Ondrias [16], Kefelioğlu [17] and Yiğit and Çolak [15], we encountered the duplicate form more than the normal form in M³ of adult specimens. In addition to these forms, we also observed the complex form. Comparison of the M³ in young and adult specimens revealed that the majority of the young specimens (76%) were normal whereas the majority of the adults (48.6%) were duplicate.

Minor differences between the measurements of *Microtus guentheri* are determined from various parts of Turkey [6, 15, 18, 19, 20]. Central Anatolian specimens are somewhat bigger than the ones from southeastern Anatolia in respect to maxillary and mandibulary toothrow length (Table 2).

Interpopulation variability, detected in molar pattern of *Microtus guentheri* examined by various authors from Turkey, is probably due to the changing environmental pressures as stated by Klimkiewicz [21] or the diet type of Guenther’s vole distributed in different habitats as well as the different interpretation of molar patterns by the authors.

Consequently, our findings from Kırıkkale province, are generally consisted with the previous data by various authors in respect to the morphotypes of M¹, M² and M³. Nonetheless, with the complex form recorded from Central Anatolia for the first time, we did not recognize regular distribution patterns of M³ in *Microtus guentheri*.

REFERENCES


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<tr>
<th>Country/Region</th>
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Table 2. Comparison of the dental measurements (mm) of *Microtus guentheri* recorded from Turkey. Numbers in the upper row indicate the range and numbers in the lower row, mean.


