Journal of Applied Biological Sciences 3(3):47-53, 2009
ISSN: 1307-1130, www.nobel.gen.tr

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

Nursel AŞAN BAYDEMİR[1] Lütfiye DUMAN*[2]

[1] University of Kırıkkale, Faculty of Science and Arts, Department of Biology, 71451 Yahşihan, Kırıkkale, TURKEY

[2] University of Kırıkkale, Graduate School of Natural and Applied Sciences, Department of Biology, 71451 Yahşihan, Kırıkkale, TURKEY

*Corresponding Author
e-mail: nurselasan@yahoo.com

Recevied : August 8, 2009
Accepted : October 4, 2009

Abstract

Microtus guentheri is one of the most widespread rodent in Turkey. Morphotypes of upper and lower molar of 89 young and adult Guenther's voles, collected from central Anatolia have been examined and compared with the previous data given from Turkey. M^2 of the young and adult specimens were non-agrestis morphotype. Young specimens possessed normal, duplicate and complex M^3, whereas adult specimens possessed simplex form in addition to those forms. The complex form of M^3 was determined from Central Anatolia with this study for the first time. Duplicate form of M^3, was encountered more than the normal form in adult specimens. M^1 of the young and adult specimens were found to be of arhombomorph type.

Key words: Guenther's vole, molar morphotype, Central Anatolia, Turkey

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 Holoarctic 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 genetical 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 pecularities [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.

*This study is a part of the MSc Thesis of Lütfiye Duman

MATERIAL AND METHODS

2.1. Study area: This study is conducted in the districts of Kırıkkale; Center (39 ° 50′ N, 33 ° 30′ E), Bahşılı (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).

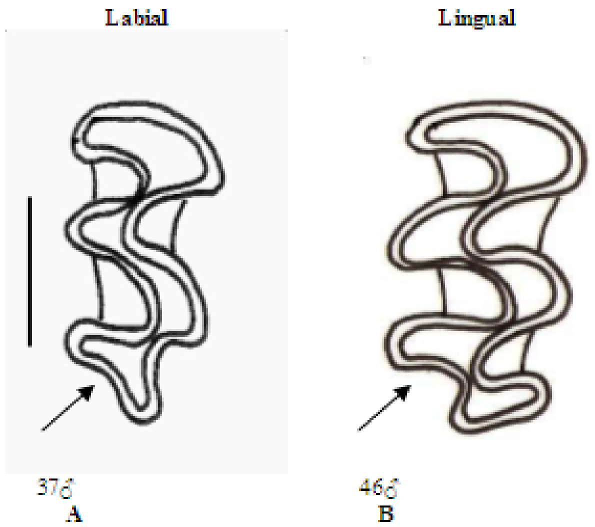
A total of 89 voles (56 male, 31 female and two undetermined sex) captured between 2001 and 2003, were examined. The age of the specimens was determined according to the general characteristics (i.e. suture line of the nasal and frontal bone) of the skull and reproductive condition. Specimens were divided 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, NFa=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 M^1, M^2, M^3, M_1, M_2 and M_3 were measured as maximum distances of occlusal surface. Box-plot diagram and histogram of the M_1 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 (M^2) of the young specimens were all found to be non-agrestis morphotype according to Corbet and Southern



[10]. M^2 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 M^2 in young (A) and agrestis morphotype of M^2 in adult (B) *Microtus guentheri* (Scale: 1mm)

Regarding the third upper molars (M^3) of the young specimens, examined according to Niethammer and Krapp [11], 13 were normal, 2 were duplicate, and 2 were complex form. M^3 of 30 adult specimens were normal, 37 duplicate, three complex, and two simplex (Fig. 2).

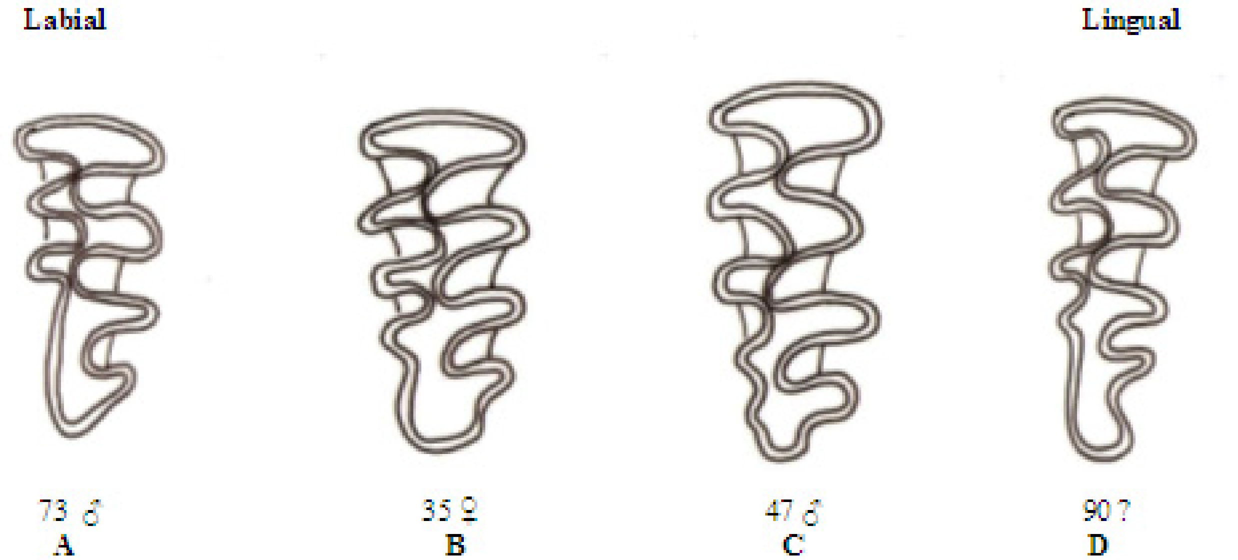


Fig. 2. Normal (A) and duplicate (B) forms of M^3 in young, complex (C) and simplex (D) form in adult *Microtus guentheri* (Scale= 1mm)

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. Sixtynine 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).

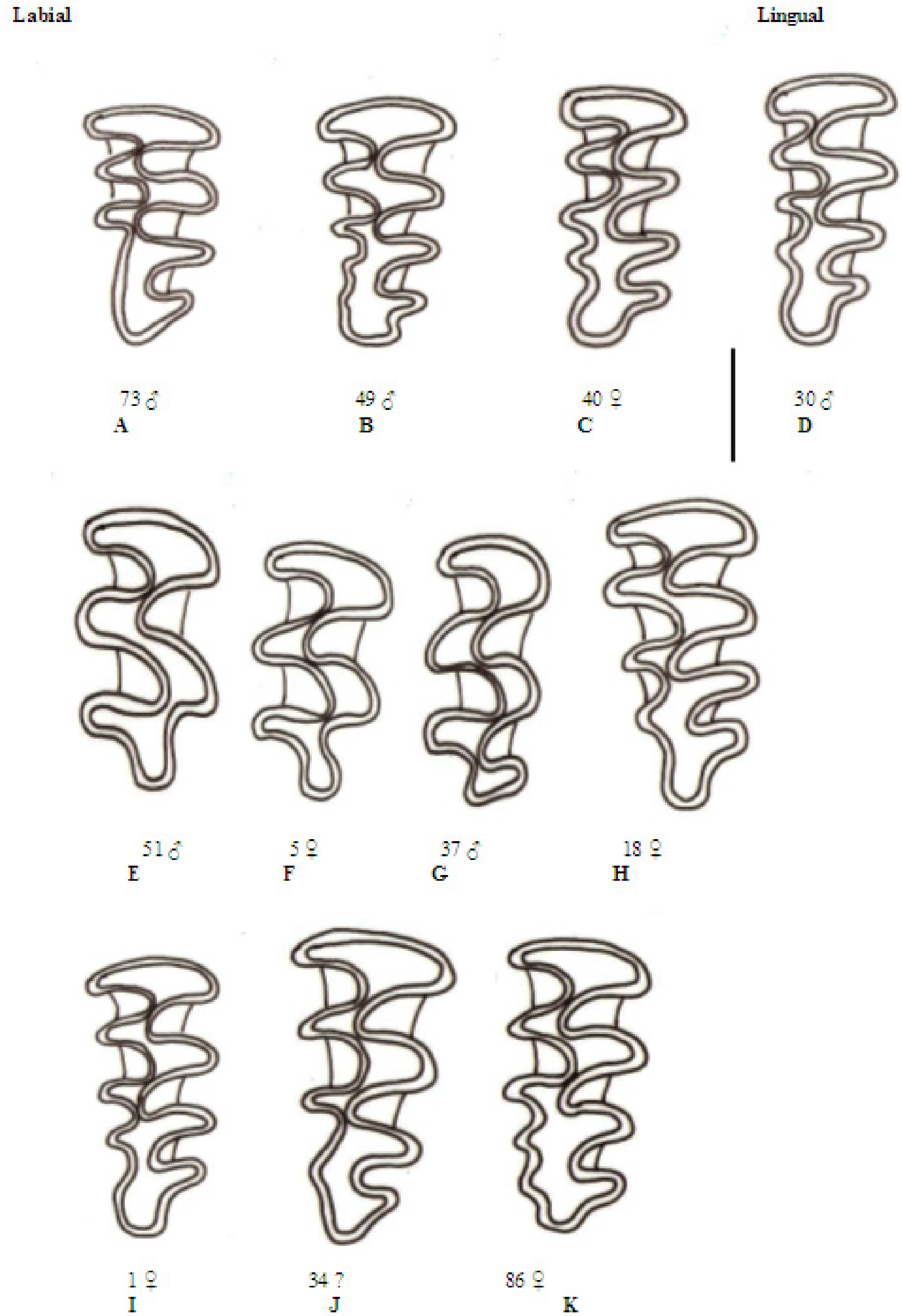


Fig. 3. Variability in the M^2 and M^3 of young and adult specimens of *Microtus guentheri*. Three closed triangles (A), no closed triangles, areas 2, 3 and 4, 5 confluent (B), two closed triangles, areas 4, 5 confluent (C), one closed triangle, areas 2 and 3 confluent (D) Two closed triangles, areas 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).

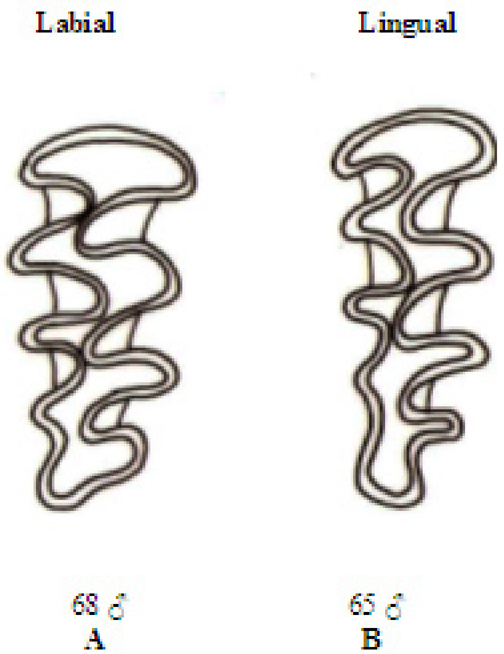


Fig. 4. Complex (A) and simplex (B) forms of M^3 of adult *Microtus guentheri* (Scale= 1mm)

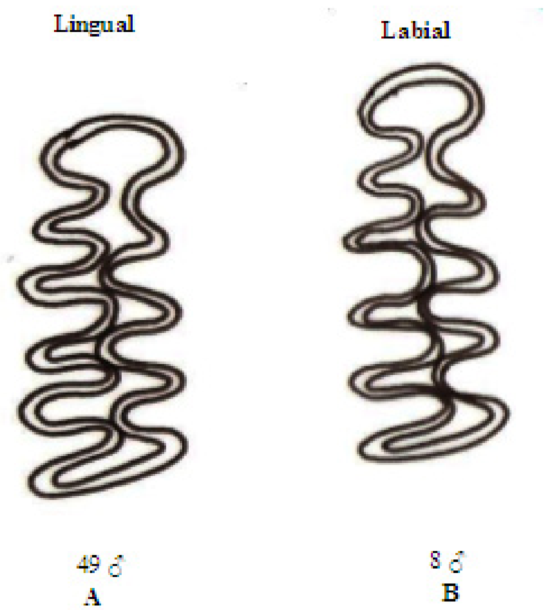


Fig. 5. Arhombomorph type of M^1 in young (A) and adult specimen (B) of *Microtus guentheri* (Scale= 1mm)

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).

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).

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

	YOUNG				ADULT			
Characteristics	N	Range	Mean	SD	N	Range	Mean	SD
C-M^3	17	5.0- 6.7	5.85	0.45	68	6.2 - 8.2	7.07	0.40
Length of M^1	17	1.7- 2.6	2.20	0.22	70	2.2 - 3.0	2.58	0.15
Length of M^2	17	1.6 - 2.0	1.75	0.12	71	1.8 - 2.3	2.03	0.12
Length of M^3	17	1.7 - 2.2	1.88	0.17	69	2.0 - 2.9	2.45	0.17
C-M_3	17	4.9 - 6.6	5.69	0.41	68	5.9 - 8.0	6.79	0.43
Length of M_1	17	2.4 - 3.1	2.73	0.20	70	2.7 - 3.9	3.23	0.24
Length of M_2	17	1.4 - 1.7	1.51	0.08	69	1.5 - 2.3	1.78	0.13
Length of M_3	17	1.1 - 2.1	1.44	0.22	69	1.5 - 2.3	1.78	0.15

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).

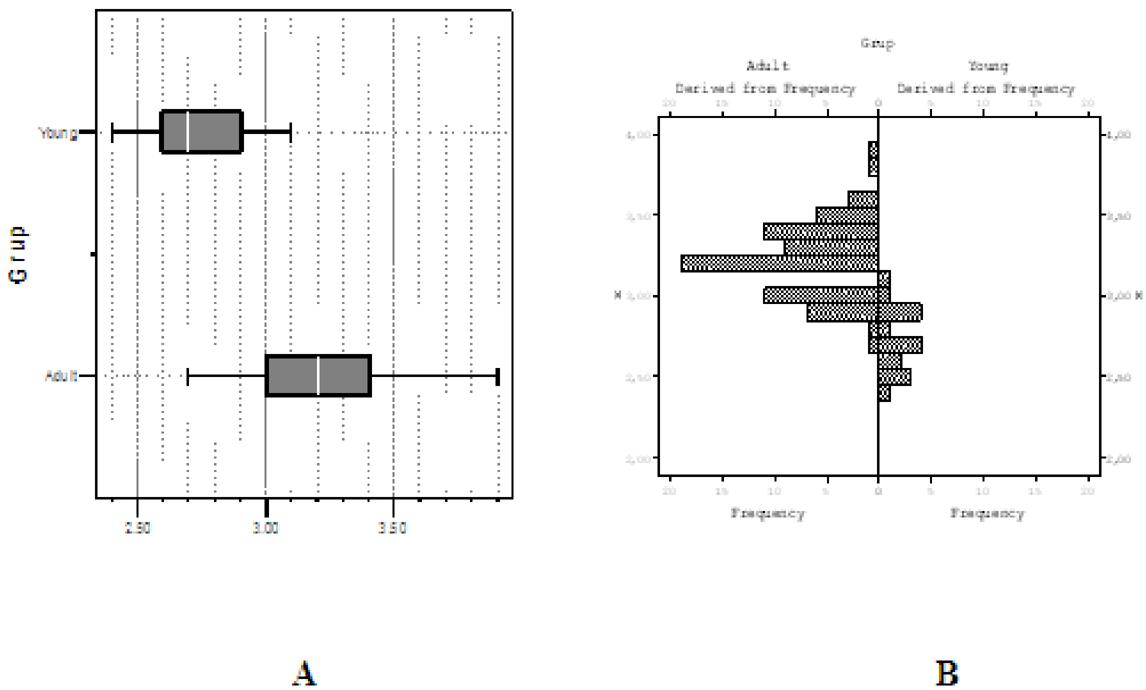


Fig. 6. Box-plot diagram (A) and histogram (B) of M^1 comparison in young and adult specimens of *Microtus guentheri*

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 ankaransis. However, Musser and Carleton [7] reported *M. lydius ankaraensis* as a synonym of *M. guentheri.*

Niethammer and Krapp [11] reported agrestis morphotype of M^2 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 determinedform in Kırıkkale province.

Kefelioğlu [17] recorded that in *M. guentheri 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. M^3 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 M^3 of adult specimens. In addition to these forms, we also observed the complex form. Comparison of the M^3 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).

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.

Locality, literature	C-M^3	M^1	M^2	M^3	C-M_3	M_1	M_2	M_3
Hatay, Kahramanmaraş, Kilis, Gaziantep (Çolak et al.1997)	6.40-6.83 (6.42)	-	-	-	5.52-6.83 (6.26)	-	-	-
İzmir, Mersin,Kahramanmaraş (Kefelioğlu and Krystufek, 1999)	6.20-7.35 (6.72)	-	-	-	-	-	-	-
Ankara (Sözen et al. 1999)	7.19-8.72 (7.90)	2.45-3.06 (2.73)	2.02-2.30 (2.10)	2.32-2.98 (2.60)	7.27-8.41 (7.70)	3.24-3.82 (3.50)	1.51-2.09 (1.80)	1.38-2.02 (1.80)
Ankara, Kırıkkale (Yiğit and Çolak, 2002)	(6.70)	-	-	-	(6.60)	-	-	-
Diyarbakır (Seçkin and Çoşkun, 2006)	5.80-7.20 (6.47)				5.5-7.3 (6.49)			
Kırıkkale (This study)	6.20-8.20 (7.07)	2.20-3.00 (2.58)	1.8-2.30 (2.03)	2.00-2.90 (2.45)	5.90-8.00 (6.79)	2.70-3.90 (3.23)	1.50-2.30 (1.78)	1.50-2.30 (1.78)

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 M^1, M^2 and M^1. Nonetheless, with the complex form recorded from Central Anatolia for the first time, we did not recognize regular distribution patterns of M^3 in *Microtus guentheri*.

REFERENCES

[1] Jaarola M, Martinkova N, Gündüz I, Brunhoff C, Zima J, Nadachowski A, Amorii G, Bulatova NS, Chondropoulos B, Fraguedakis- Tsolis S, Gonzalez-Esteban J, Lopez-Fuster M J, Kandaurov AS, Kefelioğlu H, Mathias M, Villate I, Searle J B., 2004. Molecular phylogeny of the speciose vole genus *Microtus* (Arvicolinae, Rodentia) inferred from mitochondrial DNA sequences. Mol. Phylogenet. Evol., 33: 647-663.

[2] Conroy CI, Cook JA., 2000. Molecular systematics of a holoarctic rodent (*Microtus*: Muridae). J. Mammal., 81: 344-359.

[3] Yiğit N, Kankılıç T, Çolak E., 2007. Reproductive biology and postnatal development of *Microtus rossiaemeridionalis* Ognev 1924 (Mammalia: Rodentia) distributed in Turkey. Turk. J. Zool., 31: 1-8.

[4] Danford CG, Alston ER., 1880. On the mammals of Asia Minor. Part II. Proc. Zool. Soc., 1880: 50-64.

[5] Mitchell-Jones A, Amori JG, Bogdanowicz W, Kryštufek B, Reijnders PHJ, Spitzenberger F, Stubbe M, Thissen JBM, Vohralik V, Zima J., 1999. The Atlas of European Mammals. Academic Press, London, 1-484.

[6] Kefelioğlu H, Kryštufek B., 1999. The taxonomy of *M. socialis* group (Rodentia: Microtinae) in Turkey with description of a new species. J. Nat. Hist., 33: 289-303.

[7] Musser GG, Carleton MD., 2005. Family Muridae. In: Mammal Species of the World. A Taxonomic and Geographic Reference (eds. Wilson DE, Reeder DM), pp. 989-1019. The Johns Hopkins University Press, Baltimore.

[8] Kock D, Nader IA., 1983. Pygmy shrews and rodents from the Near East. Senckenberg. Biol., 64: 13-23.

[9] Gözütok, S, Albayrak İ., 2009. Biology and Ecology of the Genus *Microtus* (Schrank, 1798) in Kırıkkale Province (Mammalia:Rodentia). IJNES, 3: 94-101.

[10] Corbet GB, Southern HN., 1977. The Handbook of British Mammals. British Museum National History, London, 1-520.

[11] Niethammer J, Krapp F., 1982. Handbuch der Säugetiere Europas, Band 2/1. Akademische Verlagsgesellschaft, Wiesbaden.

[12] Moyer CA, Adler GH, Tamarin RH., 1988. Systematics of New England *Microtus* with emphasis on *Microtus breweri*. J. Mammal., 69: 782-794.

[13] Chaline J, Graf JD., 1988. Phylogeny of the Arvicolidae (Rodentia): Biochemical and Paleontological evidence. J. Mammal., 69: 22-33.

[14] Bell C, Bever GS., 2006. Description and significance of the *Microtus* (Rodentia: Arvicolinae) from the type Irvington fauna, Alameda country, California. J. Vertebr. Paleontol., 26: 371-380

[15] Yiğit N, Çolak E., 2002. On the distribution and taxonomic status of *Microtus guentheri* (Danford and Alston, 1880) and *Microtus lydius* Blackler, 1916 (Mammalia: Rodentia) in Turkey. Turk. J. Zool., 20: 197-204.

[16] Ondrias JC., 1966. The taxonomy and geographical distribution of the rodents of Greece. Säuget. Mitt., 14: 1-136.

[17] Kefelioğlu H. 1995. Taxonomy and distribution of the genus *Microtus* (Mammalia: Rodentia) from Turkey. Turk. J. Zool., 19: 35-63. [In Turkish with English summary]

[18] Çolak E, Yiğit N, Sözen M, Özkurt Ş., 1997. Distribution and taxonomic status of the genus *Microtus* (Mammalia:Rodentia) in southeastern Turkey. Isr. J. Zool., 43: 391-396.

[19] Sözen M, Çolak E, Yiğit N., 1999. Age variations in *Microtus guentheri* Danford and Alston, 1880 (Mammalia:Rodentia) in Turkey. Turk. J. Zool., 23: 145-155.

[20] Seçkin S, Çoşkun C., 2006. Mammalian remains in the pellets of long-eared owls (*Asio otus*) in Diyarbakır province. Turk. J. Zool., 30: 271-278.

[21] Klimkiewicz MK., 1970. The taxonomic status of the nominal species *Microtus pennsylvanicus* and *Microtus agrestis* (Rodentia: Cricetidae). Mammalia, 2: 640-665.