

## On the distribution and taxonomic status of *Microtus guentheri* (Danford and Alston, 1880) and *Microtus lydius* Blackler, 1916 (Mammalia: Rodentia) in Turkey

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**Abstract:** Topotypes of *Microtus guentheri* were compared with specimens of the genus *Microtus* with  $2n=54$  chromosomes from western Anatolia. According to morphological and biometrical comparisons, it was determined that *M. guentheri* is a different species from *Microtus lydius*. The dorsal colour and the shape of the baculum distinguish *M. guentheri* from *M. lydius* morphologically. In addition, ear length, interorbital constriction, mastoid breadth, height of tympanic bulla and weight of *M. guentheri* were found to be statistically different from those of the nominate subspecies of *M. lydius* ( $p<0.05$ ). In this respect, a new subspecies of *M. lydius* is first described from central Anatolia: *Microtus lydius ankaraensis* ssp.n. In addition, our findings revealed that the population known as *M. guentheri* in Europe needs taxonomic reevaluation.

**Key Words:** Distribution, taxonomy, *Microtus guentheri*, *Microtus lydius*, *M. l. ankaraensis* ssp.n.

### Türkiye'deki *Microtus guentheri* (Danford and Alston, 1880) ve *Microtus lydius* Blackler, 1916 (Mammalia: Rodentia)'un Taksonomisi ve Yayılışı Üzerine Bir Çalışma

**Özet:** *Microtus guentheri*'nin topotipleri Batı Anadolu'da yayılış gösteren *Microtus* cinsinin  $2n=54$  kromozomlu örnekleri ile karşılaştırıldı. Morfolojik ve biyometrik karşılaştırmalar sonucu *M. guentheri*'nin *M. lydius*'tan ayrı bir takson olduğu belirlendi. Dorsal renk ve bakulum şekli *M. guentheri*'yi *M. lydius*'tan ayırmaktadır. Bunlara ilaveten, *M. guentheri*'nin kulak uzunluğu, interorbital genişliği, mastoid genişliği, timpanik bulla yüksekliği ve ağırlığı *M. lydius*'un nominatif alttüründen istatistiki olarak farklı bulundu ( $p<0.05$ ). Bu bulgular dikkate alınarak İç Anadolu'dan *Microtus lydius ankaraensis* ssp. n. tanımlandı. Ayrıca bulgularımız Avrupa'da *M. guentheri* olarak bilinen popülasyonun tekrar taksonomik bir değerlendirmeye alınması gerektiğini ortaya koymuştur.

**Anahtar Sözcükler:** Yayılış, taksonomi, *Microtus guentheri*, *Microtus lydius*, *Microtus lydius ankaraensis* ssp. n.

### Introduction

*Microtus guentheri* was described from Kahramanmaraş by Danford and Alston (1). Afterwards, Blackler (2) described *Microtus lydius* from İzmir. Ellerman and Morrison-Scott (3) regarded *M. lydius* as a subspecies of *M. guentheri*. In contrast, Corbet (4) and Harrison and Bates (5) considered *M. guentheri* to be a synonym of *Microtus socialis*. Corbet (4) also regarded *M. lydius* as a subspecies of *M. socialis*. Apart from these taxonomic remarks, *M. guentheri* was recorded from various localities in Anatolia by Neuhäuser (6), Misonne (7), Kock et al. (8), Osborn (9), Steiner and Vauk (10), Lay (11), Felten et al. (12), Morlok (13), Kefelioğlu (14), Çolak et al. (15), and Kefelioğlu and Krystufek (16). The recent revisions confirmed that *M. guentheri* is a valid species (17,18), ranging from Israel, Lebanon, and Syria to Greece, Bulgaria and Yugoslavia (5,17,19,20,21,22).

In this study, we discuss the distribution areas and taxonomic status of *M. guentheri* and *M. lydius*.

### Materials and Methods

About 500 specimens of the genus *Microtus* were collected from various localities in Turkey, and they were examined with regard to morphological, biometrical and karyological characteristics. Topotypes of *M. guentheri*, *M. lydius*, and other specimens with  $2n=54$  were considered in the taxonomic evaluation. Specimens were caught by snap traps and Sherman live traps. Twenty measurements (mm) and the weight (g) were obtained from each animal, together with two measurements of the baculum. Only the right side was measured in paired characteristics in order to avoid undesirable variation. The classifications of molar teeth were performed in

accordance with Niethammer and Krapp (17). Reproductive signs such as lactation, pregnancy, swollen testes and placental scars were recorded in the field and laboratory in order to determine the age of the voles. After the ages of the specimens were determined, adult measurements were used in morphological and biometrical evaluations. Biometric comparison was performed by t-test (Microsoft Excel t-test Two – Sample Assuming Unequal Variance). The skulls, phalli and bacula were carefully drawn under binocular microscope in order to examine and compare morphological structures. Live specimens were karyotyped using the technique of Ford and Hamerton (23). A total of 10 to 20 slides were prepared for each specimen karyotyped, and at least 15 well-spread metaphase cells from each preparation were analysed. Skins and skulls of the specimens have been deposited in Department of Biology, Faculty of Science, Ankara University.

Abbreviations used in the text: TBL: Total length, TL: Tail length, HFL: Hind foot length, EL: Ear length, W: Weight (g), ZB: Zygomatic breadth, IC: Interorbital constriction, CBL: Condylbasal length, ONL: Occipitonasal length, BL: basal length, NL: Nasal length, MAB: Mastoid breadth, OW: Occipital width, DL: Diastema length, PL: Palatal length, LI: Length of incisiva, MAL: Mandible length, UML: Upper molar alveolar length, LML: Lower molar alveolar length, HB: Height of braincase with bulla, HTB: Height of tympanic bulla, LB: Length of baculum, WB: Width of baculum.

## Results

*Microtus guentheri* (Danford and Alston, 1880)

1880. *Arvicola guentheri*, Danford and Alston, Proc. Zool. Soc. 62.

**Type locality:** Türkoğlu / Kahramanmaraş, Turkey (the name Maraş, indicated as the type locality in the original paper, is the former name of Kahramanmaraş).

**Distribution and habitat:** *M. guentheri* was recorded from Kahramanmaraş, Reyhanlı (Hatay), Kilis and Nizip (Gaziantep). The altitudes of these localities vary from 500 to 600 m, and this vole is only distributed across south-eastern Turkey (Fig. 1). According to our findings, their distribution into Central Anatolia is prevented by high mountains that extend from south to north with an altitude of over 1000 m. This mountainous region is also known as the Anatolian Diagonal (Fig. 1). This vole lives

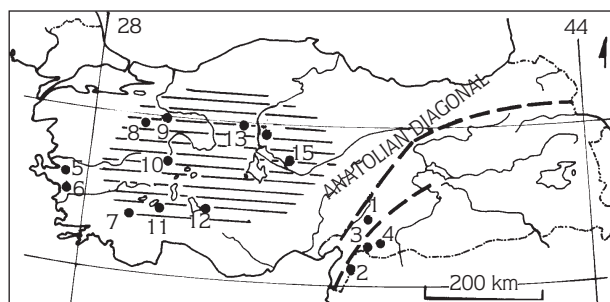


Fig. 1. Recorded localities of *M. guentheri* (1-4), *M. lydius* (5-6) and *M. l. ankaraensis* (7-15), the hatched area shows likely distribution of *ankaraensis*. 1. Kahramanmaraş, 2. Reyhanlı (Hatay), 3. Kilis, 4. Nizip, 5. İzmir, 6. Aydın, 7. Acıpayam (Denizli), 8. Kütahya, 9. Eskişehir, 10. Afyon, 11. Burdur, 12. Beyşehir (Konya), 13. Ankara, 14. Kırıkkale, 15. Kırşehir.

in meadows, watery plains, riverbanks, and usually occupies clover fields in south-eastern Turkey.

**Diagnosis:** Dorsal colour is uniformly dark brownish, and it is somehow reminiscent of blackish brown. The tail is distinctly bicoloured, being dark brownish dorsally and dirty white ventrally. The mastoid portion of the tympanic bulla is poorly developed, and is almost visible in dorsal view.

**External characteristics:** The maximum total and tail lengths were 154 mm and 29 mm, respectively. The tail is length equal to 23.4% of head and body length. The average measurements of cranial characteristics, phallus and baculum are given in the Table. The ear length of *M. guentheri* is statistically longer than in the specimens from İzmir ( $P < 0.05$ ). Dark brownish dorsal fur extends from nose tip to the upper end of the tail. The inner surface of the ear is covered with short, sparse whitish hair, and the outer surface is the same colour as the dorsal. The tail is bicoloured: short dark brownish hair dorsally and dirty white hair ventrally. The upper side of the forefoot is covered with paler hair than the dorsal fur, but the under parts are darker. The colour of the hind feet is the same as in the forefeet. The hair of the ventral fur is whitish grey, but the line of demarcation is not distinct along the flanks.

**Cranial characteristics:** The skull exhibits general peculiarities of the genus *Microtus*. The maximum occipitonasal and condylbasal lengths were measured at 28.8 mm and 28.6 mm, respectively. The cranial measurements are given in the Table. Three cranial

measurements (IC, MAB, HTB) and the weight of *M. guentheri* are significantly different from the İzmir population of *M. lydius* ( $P < 0.05$ ). Because of the lack of sufficient bacula, LB and WB of these taxa were not statistically considered. Nasal bones do not attain the alveoli of the upper incisors. That is why the condylobasal length is usually greater than the occipitonasal length. The rostrum is not markedly long and the nasals are rounded off posteriorly. The maxillary process of the zygomatic arc is slightly, laterally widened, and the interorbital constriction is broad. There are no marked ridges on the border of the parietal and interparietal bones, but the supraoccipital ridge is markedly developed in adult specimens. The brain case is relatively, posteriorly smooth in the parietal and interparietal regions of the skull. The occipital condyles and mastoid portion of the tympanic bulla are visible in dorsal view. The incisive foramina are of moderate size and their posterior ends do not reach the front front of  $M^1$ . The postpalatal foramina that are located at the level of  $M^3$  are point-sized. The anterior parts of tympanic bulla closely touch the tip of the pterygoid process. The mandible is slender and its coronoid process is relatively robust and is markedly separated from the condyloid process. The incisor is orange pigmented and orthodont. The occlusal molar patterns of  $M^2$  are of the non-agrestis morphotype, and  $M^3$  was observed in 85% normal and 15% duplicated form.

**Phallus and baculum:** The phallus is club-shaped with no distinctive features, and is covered with minute

bubbles. There is a small protrusion on the anterior tip of the phallus that is visible in the dorsal view (Fig. 2). The baculum is composed of two main parts, distal and proximal. The distal part of the baculum is cartilaginous and the proximal is osseous. The osseous baculum also consists of two parts, the first being the base and the second being the shaft. The base of the baculum is very distinctive for *M. guentheri*. It is triangular and strongly, posteriorly protruded upward. There is a deep concavity on the under side of base. The shaft is club-shaped and tapered with a bulbous tip (Fig. 3).

**Karyology:** The diploid number of chromosomes is  $2n=54$ . Autosomes consist of 52 acrocentrics or 51 acrocentrics and 1 metacentric. The X chromosome is either metacentric or acrocentric, but the Y chromosome is the smallest acrocentric.

Specimens examined ( $n=114$ ): Kahramanmaraş 23 (9 ♂, 14 ♀), Antakya 38 (21 ♂, 17 ♀), Kilis 46 (18 ♂, 28 ♀), Nizip 7 (6 ♂, 1 ♀).

*Microtus lydius lydius* Blackler, 1916

1916. *Microtus lydius*, Blackler, Ann. Mag. nat. Hist. Vol. XVII 426–427.

Type locality: İzmir, Turkey.

**Distribution and habitat:** *M. lydius* is distributed in the coastal parts of western Turkey (Fig. 1). We recorded this species from a few localities around İzmir and Aydın. It lives in pastures and fields in this province, and sometimes occupies the olive plantations.

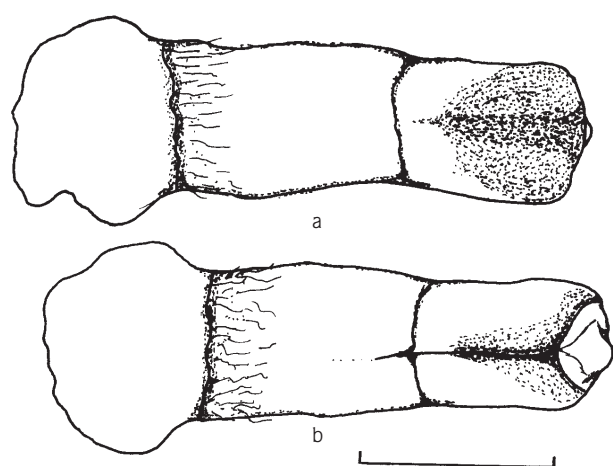


Fig. 2. The phallus of *M. guentheri*, a: dorsal, b: ventral view. Scale: 5 mm.

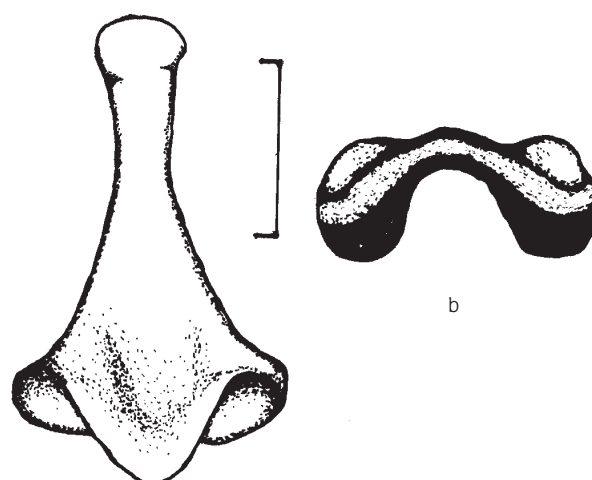


Fig. 3. The baculum morphology of *M. guentheri*, a: dorsal, b: basal view. Scale: 1 mm.

**Diagnosis:** The fur on the dorsal aspect is yellowish brown. The tail is not markedly bicoloured, the upper and under sides are similar to the dorsal colour. The mastoid portion of the tympanic bulla is not swollen.

**External characteristics:** The maximum total and tail lengths approach 177 mm and 33 mm, respectively. Tail percentage to head and body length was found to be 24.1%. The average measurements and standard deviations are given in the Table. The dorsal colour of this vole is yellowish brown, and shows uniformity extending to the tail from the nasal tip, but a darker median line is sometime evident on the dorsal fur. The ear is relatively short and concealed beneath the dorsal fur. The inner and outer parts of the ear are covered with short yellowish brown hairs. The tail is also covered with short hair, and its colour is dorsally and ventrally the same as the dorsal fur, but its ventral colour is sometime slightly paler than the dorsal colour. That is why it sometimes seems to be bicoloured. The upper side of the forefeet is dull yellowish but its ventral part is dirty white. The upper side of the hind feet is also dull yellowish but its ventral part is darker. The ventral fur is dirty white grey. The line of demarcation along the flanks is not clearly distinct.

**Cranial characteristics:** The maximum occipitonasal and condylobasal lengths are 29.9 mm and 29.3 mm, respectively. The brain case is not smooth and it is rounded and slopes down posteriorly at the parietal and interparietal bones. The molar enamel patterns in the M<sup>2</sup> and M<sup>3</sup> were found to be the non-agrestis morphotype and the normal form, respectively. Other cranial characteristics are consistent with the previous species.

**Phallus and baculum:** Phallus morphology is the same as in *M. guentheri*. The shaft of the osseous baculum is similar that of the previous species. The base shows considerable variations among adults; it is generally disk-shaped, but some of them are spoon-shaped. Apart from these, there is a recess on the basal of some bacula (Fig. 4.a-e). It was also determined that the variations in Figure 4.c,d,e are the mostly frequent types of baculum. The base of the osseous baculum has very poorly developed concavity in both upper and under parts.

**Karyology:** The diploid number of chromosomes is 54. The chromosome morphologies are the same as in the previous species.

Species and Localities	<i>Microtus guentheri</i> (Kahramanmaraş)		<i>Microtus lydius</i> (İzmir, Aydın)		<i>M. l. ankaraensis</i> (Ankara)	
	n	Mean ± SD	n	Mean ± SD	n	Mean ± SD
TBL	23	134.3 ± 9.8	44	132.4 ± 15.7	69	143.7 ± 14.5
TL	22	25.5 ± 2.4	44	25.7 ± 3.8	67	28.9 ± 4.9
HFL	23	19.8 ± 1.0	44	19.9 ± 1.4	69	21.5 ± 1.2
EL	23	13.0 ± 0.6	44	12.1 ± 1.2	69	13.4 ± 1.3
W (g)	23	33.3 ± 5.9	44	27.8 ± 9.5	69	41.6 ± 11.4
ZB	13	15.7 ± 0.8	43	15.1 ± 1.0	42	16.6 ± 1.3
IC	13	3.9 ± 0.2	44	3.7 ± 0.1	44	3.8 ± 0.1
CBL	10	26.7 ± 1.3	44	26.4 ± 2.4	42	28.3 ± 1.9
ONL	10	26.9 ± 1.2	44	26.2 ± 2.3	41	28.2 ± 1.7
BL	9	25.4 ± 1.4	44	24.4 ± 1.7	42	26.6 ± 1.8
NL	13	7.3 ± 0.4	45	7.3 ± 0.6	46	8.0 ± 0.6
MAB	11	9.7 ± 0.4	44	9.3 ± 0.6	45	10.4 ± 1.2
OW	11	12.9 ± 0.7	44	12.5 ± 0.8	44	13.6 ± 0.8
DL	13	8.0 ± 0.6	45	8.1 ± 0.7	46	8.7 ± 0.6
PL	12	13.4 ± 0.6	45	13.0 ± 0.9	44	14.3 ± 0.9
LI	12	4.5 ± 0.3	44	4.3 ± 0.4	45	4.8 ± 0.4
MAL	14	16.5 ± 0.7	45	16.3 ± 1.2	47	17.9 ± 1.2
UML	14	6.3 ± 0.2	45	6.3 ± 0.3	46	6.7 ± 0.3
LML	14	6.2 ± 0.3	45	6.2 ± 0.3	47	6.6 ± 0.3
HB	11	10.0 ± 0.4	44	9.8 ± 0.4	45	10.6 ± 0.4
HTB	12	7.6 ± 0.4	45	7.0 ± 0.4	45	7.9 ± 0.5
LB	4	2.5 ± 0.1	7	2.3 ± 0.5	14	2.9 ± 0.3
WB	4	1.5 ± 0.1	7	1.0 ± 0.4	14	1.5 ± 0.3

Table. Measurements and weights of the adult specimens of *Microtus guentheri*, *Microtus lydius* and *M. lydius ankaraensis*. n: specimen numbers, SD: standard deviation.

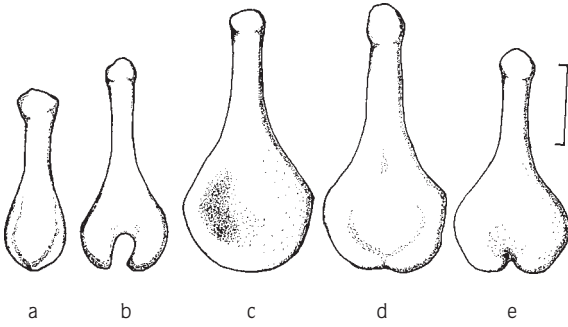


Fig. 4. Baculum variation of *M. lydius lydius* and *M. lydius ankaraensis* (dorsal view). Scale: 1 mm.

**Specimens examined:** İzmir and Aydın 50 (24 ♂, 26 ♀).

*Microtus lydius ankaraensis* ssp. n.

**Type locality:** The village Sarayköy, 15 km north of Ankara, Turkey.

**Distribution and habitat:** This subspecies is distributed throughout central Anatolia. We examined specimens from 8 different localities in their distribution areas, and it was determined that this vole actually lives in virgin pastures and steppes in central Anatolia. It sometime occupies grain fields, and the burrows are usually located at the edges of the fields where agricultural activities causing habitat restriction are very intensive.

**Holotype:** An adult male with collection number 1906 from Gümüşoluk village (15 km north of Ankara). Holotype collected 19 September 1996 by Dr. Nuri Yiğit. Skin, skull, phallus, baculum and karyotype preparations were deposited in the Department of Biology, Faculty of Science, Ankara University.

**Measurements of holotype (mm):** TBL: 165, TL: 31, HFL: 22, EL: 16, W: 65 g., ZB: 18.7, IC: 3.8, CBL: 31.2, ONL: 30.7, BL: 29.4, NL: 8.8, MAB: 10.7, OW: 14.6, DL: 10.0, PL: 16.1, LFI: 5.4, MAL: 20.1, UML: 7.1, LML: 7.2, HB: 11.6, HTB: 8.4, LB: 2.9, WB: 1.5.

**Paratypes:** Gümüşoluk (15 km north of Ankara), Kurtboğazi (43 km north-west of Ankara), Gölbaşı (25 km south of Ankara) 30 ♀, 39 ♂. The measurement of the paratypes is presented in the Table.

**Other material:** Acipayam (Denizli) 8 (3 ♂, 5 ♀), Kütahya 3 (1 ♂, 2 ♀), Eskişehir 28 (16 ♂, 12 ♀), Afyon

18 (10 ♂, 8 ♀), Burdur 3 (1 ♂, 2 ♀), Beyşehir (Konya) 11 (4 ♂, 7 ♀), Kırıkkale 8 (4 ♂, 4 ♀), Kırşehir 7 (5 ♂, 3 ♀).

**Diagnosis:** The dorsal colour is generally the same as in the nominate subspecies, but its darker median line is more marked than in nominative subspecies. The dorsal colour gets warmer toward the back. The under parts of the forefeet are covered by yellowish hair, but it is short and whitish on the under parts of the hind feet.

**External characteristics:** The maximum total and tail lengths are 177 mm and 38 mm, respectively. Tail length percentage to head and body length is greater than in previous taxa, and approaches 25.2%. We statistically compared four external characteristics and weights of the specimens from Ankara - İzmir and Ankara - Kahramanmaraş. All external characteristics and weight of this subspecies show differences from the nominative subspecies ( $p < 0.05$ ). In addition to these, TBL, TL, HFL and W of *M. l. ankaraensis* were found to be statistically greater than those of *M. guentheri* ( $p < 0.05$ ). Average of external, cranial and baculum measurements, along with weight, are presented in the Table. The dorsal fur is yellowish brown but it is slightly orange toward the back, becoming paler on the sides. The darker median line is well marked in some specimens. Ears are longer than those of the nominative subspecies. The inner parts of the ear are covered with short and sparse yellowish hair. The outer parts are the same as the inner parts but longer. The colour of the tail is similar to that of the nominative subspecies, but slightly paler. The hair covering the upper and under sides of the forefeet is long and dull yellowish. The upper side of the hind feet is also dull yellowish but its ventral part is shorter and whitish. The colour of the ventral fur is dirty white with yellowish speckles. The line of demarcation along the flanks is not distinct.

**Cranial characteristics:** The maximum occipitonasal and condylobasal lengths are 31.2 mm and 30.2 mm, respectively. All cranial characteristics of *M. l. ankaraensis* were found to be statistically longer than in *M. l. lydius* and *M. guentheri* ( $p < 0.05$ ), except for HTB of *M. guentheri*. There is no statistical difference for HTB between *M. guentheri* and *M. l. ankaraensis*. In spite of the statistical differences, the cranial morphologies of *ankaraensis* are almost the same as in both *M. l. lydius* and *M. guentheri*. However, the occlusal molar patterns of the specimens were observed in 85% normal, 9% duplicated and 6% simplex forms.

**Phallus and baculum:** Phallus and baculum morphologies show similar variations to those of *M. lydius*.

**Karyology:** We karyotyped at least 10 specimens from three different locations in Ankara. We found that the diploid chromosome number is  $2n=54$ , and the karyotype is composed of acrocentric chromosomes, as in the previous species.

**Etymology:** Named *ankaraensis* due to the type locality being around Ankara, the capital city of Turkey.

## Discussion

Ellerman and Morrison-Scott (3) included Libya, Syria, Palestine, Turkey and Greece in the distribution areas of *M. guentheri*. Bodenheimer (19) suggested that *M. guentheri* is the common vole in all plains around the Mediterranean. Later, the same findings for its distribution were reported by Ondrias (9), Niethammer and Krapp (17), Wilson and Reeder (18), Lehmann (20), and Atallah (21). In contrast, our findings show that the Anatolian Diagonal borders the distribution of *M. guentheri* in the west. The mountainous regions likely prevent *M. guentheri* from penetrating into central Anatolia. In this respect, the distribution of *M. lydius* is also restricted to western Anatolia, extending from the coastal region in the west to central Anatolia.

Danford and Alston (1) described *M. guentheri* from two specimens collected from Kahramanmaraş. They also indicated that its tail length is about 20% of head and body length. Blackler (2) stated that *M. guentheri* is distinguishable from *M. lydius* by its longer tail and greyish white belly. According to Neuhäuser (6), Kefelioğlu (14), and Lehmann (20), the main difference is the dorsal coloration among these taxa. In contrast to Blackler (2), we did not find any statistical difference in tail lengths of both nominative subspecies of *guentheri* and *lydius*. But our findings are consistent with the dorsal colour of *M. guentheri* given by the authors above. Neuhäuser (6) described *M. guentheri shevketi* from Tarsus (Adana), and reported that the brownish, reddish dorsal colour occurs in the eastern specimens of this subspecies. Misonne (7) provided similar findings for *M. guentheri* from Gaziantep. In addition to these, Misonne (7) also reported that the tail of this taxon is very short and bicoloured, and the upper and the under parts of this vole are reddish and greyish in coloration, respectively.

Çolak et al. (15) recorded *Microtus irani* from Kilis, near Gaziantep. They emphasized that the reddish brown dorsal colour and a different number of chromosomes separate *M. irani* from *M. guentheri*. This finding suggests that the colours of *M. guentheri* and *M. irani* may have been confused with each other in the descriptions by Neuhäuser (6) and Misonne (7). The bicoloured tail of *M. guentheri* and *M. lydius* was reported by Neuhäuser (6), Misonne (7), Kefelioğlu (14), Kefelioğlu and Krystufek (16), and Ondrias (22). However, Neuhäuser (6) also suggested that the tail of *M. guentheri* is slightly bicoloured. According to our findings, the tail of *M. guentheri* is strikingly bicoloured, and is very different from that of *M. lydius*. Up to now, distinctive cranial characteristics have not been found for *M. guentheri* and *M. lydius*. According to our examinations, there is no striking cranial difference between these taxa, except for the weakly posteriorly rounded braincase of *M. lydius*. Atallah (21) stated that the mastoid portion of the auditory bulla of Lebanese specimens was poorly developed and was not visible in dorsal view. A small tympanic bulla with the mastoid portion poorly developed was similarly reported by Neuhäuser (6), Kefelioğlu (14), Çolak et al. (15), and Kefelioğlu and Krystufek (16). All these definitions are generally consistent with our findings. Unlike Atallah (21) we determined that the mastoid portion of the tympanic bulla, even poorly developed, is visible in dorsal view, as well as the occipital condyles as seen in Çolak et al. (15) and Niethammer and Krapp (17). Atallah (21) also noted that the height of the tympanic bulla is less than 10 mm in Lebanese specimens, and the tail length percentage of head and body length varies from 20% to 25%. Kefelioğlu (14) also reported that the tail length is about 20% of head and body length in the nominative subspecies of *M. guentheri*. Our findings are similar to those given by the authors above. Niethammer and Krapp (17) stated that the molars were geographically quite uniform, and the specimens of *M. guentheri* with *agrestis* morphotype, which is very rare in western Anatolia were reported from south-east Anatolia. In contrast, we found non-*agrestis* morphotype in the topotypes of *M. guentheri* and *M. lydius*. This finding is similarly reported for the specimens from western Anatolia and Greece by Ondrias (24). Apart from  $M^2$ , Felten et al. (12) and Ondrias (22) also reported that  $M^3$  is the most normal form of the specimens of western Anatolia and Greece. This finding is consistent with our results. However,

Kefelioğlu and Krystufek (16) noted that the morphology of the molar enamel pattern does not provide categorical differences between *Microtus socialis*, *Microtus guentheri* and *Microtus dogramacii*. In this study, the shape of the baculum was determined to be a taxonomic characteristic for *M. g. guentheri*, and its shape clearly distinguishes *M. g. guentheri* from *M. lydius*. In addition to the distinctive baculum shape of the specimens from the type localities, the same bacula were found in the specimens of *guentheri* from other localities in south-east Turkey. Kefelioğlu (14), Çolak et al. (15), and Kivanç (25) also reported this distinctive shape of the baculum without specifying its taxonomic importance. The karyotype was also found to not separate *M. guentheri* from *M. lydius*. The detailed karyologic results were provided for these taxa by Kefelioğlu (14) and Çolak et al. (15). They reported variations in the X chromosome in both topotypes of *M. guentheri* and *M. lydius*. Our findings confirm the karyotype given for these species by the above authors. In spite of the similarities in cranial morphologies and karyotypes, the distinct features such as dorsal colour, the shape of the baculum and certain biometric characteristics showed the specimens from İzmir to be a valid species, *M. lydius*. The specimens from central

Anatolia were therefore described as a subspecies of *M. lydius* due to the significant differences in external and cranial measurements. Furthermore *M. lydius* can be considered an endemic species of western Anatolia. Apart from *M. lydius*, the subspecies status of *M. guentheri* remains unclear. The subspecies of *M. guentheri* nearest to the nominative subspecies are *Microtus guentheri philistinus* Thomas (26) and *Microtus guentheri shevketi* Neuhäuser (6). Thomas (26) and Neuhäuser (6) described these subspecies from Jaffa (Palestine) and Tarsus (Turkey), respectively. In order to determine if *M. g. philistinus* and *M. g. shevketi* are valid subspecies, the sampling area should be extended to the southern and western range of species, and a sufficient number of specimens should be collected from their type localities. In addition to the subspecific status of *M. guentheri*, the European population of *M. guentheri* should be taxonomically evaluated again.

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