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The Bioecology of *Meriones tristrami* Thomas, 1892 in Kırıkkale Province (Mammalia: Rodentia)

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Abstract

This study is based on 40 *Meriones tristrami* specimens caught in Kırıkkale province in 2002 and 2003. The habitat, ectoparasites, burrow type, fur colour, some feeding and breeding features, baculum, karyotype, and external and cranial measurements of this species are reported. Information on the feeding and behaviour of 7 animals in a laboratory setting was recorded over 8 months. The diploid chromosome number (2n) is 72, the fundamental number (FN) is 84, and the number of autosomal arms (FNa) is 80. In this species, the hair scale form is described from Turkey for the first time in this study. The form of the hair scale, examined by scanning electron microscope (SEM), was "coronal simple" at the tip of the hair and "imbricate flattened" at the shaft and at the basal part. Moreover, the tick species *Ixodes ricinus* and the flea species *Nosopsyllus durii* are reported from *M. tristrami* in Turkey for the first time.

Key words: *Meriones tristrami*, ecology, biology, karyotype, Kırıkkale province.

INTRODUCTION

There are 31 genera and 67 species of rodents known in Turkey. Among these, there are six species of the genus *Meriones*: *Meriones tristrami*, *Meriones vinogradovi*, *Meriones dahli*, *Meriones crassus*, *Meriones persicus*, and *Meriones libycus* in Turkey. Six subspecies of *M. tristrami* are distributed in Turkey: *M. t. blackleri*, *M. t. intraponticus*, *M. t. lycaon*, *M. t. kilisensis*, *M. t. bodenheimeri*, and *M. t. bogdanovi* [1]. Only *M. tristrami* is known to occur in Kırıkkale province [2,3].

Korobitsyna [4] stated that polymorphism was detected in the fundamental autosomal number (NFa) of *M. tristrami*, having pericentric inversions. According to Korobitsyna and Korablev [5], the diploid chromosome number remained stable, although Vorontsov and Korobitsyna (1969) recorded 5 pairs of biarmed chromosomes in the specimens from the Palearctic, Orlov (1969) recorded 6 pairs of biarmed chromosomes, and Herman (1973) recorded 4 pairs of biarmed chromosomes from Israeli specimens. Kefelioğlu [6] determined that in Turkish specimens the diploid chromosome number was stable, whereas there were 2 karyotypic forms, having different NFa. According to that author, in the specimens from Aralık and Iğdır, 2n=72, NF=80 and NF=84 karyotypes were detected at the same frequency, whereas in the specimens from Çorum through Kastamonu the 2n=72, NF=84 and NFa= 80 form was seen more frequently.

There are numerous publications addressing the distribution, ecology, biology, taxonomy, and karyology of *M. tristrami* in Turkey [7-14].

The aim of this study was to determine some ecological, biological, and karyological characteristics of *M. tristrami* in Kırıkkale province.

MATERIALS AND METHODS

We examined 40 *M. tristrami* specimens caught from 10 localities in Kırıkkale province between September 2002 and December 2003. The specimens were divided into three age groups (young, subadult, and adult) depending on the amount of wear on the molars [15], baculum characteristics [6], and field notes. ANOVA was used to check for differences between age groups. Sexual differences within the age groups were tested using the non-parametrical Mann-Whitney test. Measures of both sexes were combined because no statistically significant differences were found. The specimens were prepared as conventional dried museum skins after four standard external measurements and weight were recorded [16]. Habitat, burrow type, fur colour, feeding, breeding, behaviour, baculum, hair scale form, karyology, and external and cranial measurements of the species were recorded. Fleas and ticks collected as ectoparasites were identified by specialists.

Skulls were prepared according to Mursaloğlu [16], bacula according to Lidicker [17], and karyological slides according to Patton [18]. The centromeric index of chromosomes was evaluated according to Levan et al. [19]. The chromosomes of two males were analysed, and at least 7 well-spread metaphase cells were prepared from each. The guard hairs were taken from the shoulder blades dorsally and prepared according to Hayat [20]. The hair scale form was determined according to Benedict [21]. Skull measurements were taken according to Chetboun and Tchernov [22] and Harrison and Bates [23]. Voucher specimens were deposited at the Department of Biology, Faculty of Sciences and Arts, Kırıkkale University.

The specimens examined (n=40) were as follows: Bahşılı: Doğanay, 2 (2 ♂♂, 8 November 2002), Çeşme, 1 (1 ♀, 18 July 2003); Balışeyh: Büklüce, 3 (2 ♂♂, 1 ♀, 15 May 2003), Velioluğu, 2 (1 ♂, 1 ♀, 14 September 2003); Delice: Çömelekkaya, 12 (2 ♂♂, 8 ♀♀, 21 September 2002; 2 ♂♂,

30 September 2003); Karakeçili: Sulubük, 6 (2 ♂♂, 2 ♀♀, 4 June 2003; 1 ♂, 1 ♀, 5 June 2003); Keskin: Kurşunkaya, 1 (1 ♀, 18 September 2003); Centrum: Karacaali, 3 (2 ♂♂, 1 ♀, 22 September 2003); Sulakyurt: Faraşlı, 1 (1 ♀, 29 September 2003); Yahşihan: Campus of Kırıkkale University, 9 (2 ♂♂, 27 December 2002; 2 ♂♂, 1 ♀, 2 May 2003; 2 ♀♀ 13 May 2003; 1 ♂, 9 July 2003; 1 ♀, 21 November 2003) (Figure 1).

RESULTS

In Kırıkkale province *Meriones tristrami* generally lives on steppe hill slopes, plains, and field edges.

Meriones tristrami Thomas, 1892

1892. *Meriones tristrami* Thomas, Ann. Mag. Nat. Hist. (6) 9: 148.

Type locality: Dead Sea region, Palestine.

Habitat: *Meriones tristrami* is found to live at altitudes up to 1140 m in the steppe region of Kırıkkale province. We observed that its habitat includes herbs (*Achillea* sp., *Alcea* sp., *Anchusa* sp., *Anthemis* sp., *Centaurea solsitialis*, *Centaurea virgata*, *Cichorium intybus*, *Echinophora tournefortii, Eryngium campestre*, *Euphorbia macroclada, Festuca* sp., *Heliotropium lasiocarpum*, *Hordeum sativum*, *Marrubium* sp., *Mentha longifolia* subsp. *thyphoides*, *Salvia* sp., *Sanguisorba minor* subsp. *muricauta, Sanguisorba minor* subsp. *minor, Trifolium* sp., *Triticum vulgare, Verbascum* sp.) and bushes (*Astragalus* sp. and *Vitis* sp.). Other rodents sympatric with *M. tristrami* include *Microtus guentheri* and *Cricetulus migratorius*.

Ectoparasites: Two ectoparasites, the tick species *Ixodes ricinus* Linnaeus, 1758 and the flea species *Nosopshyllus durii* Hubbard, 1956, occurred on the 5 specimens examined.

Burrow type: *Meriones tristrami* burrows were encountered on flat and slightly sloping areas. We excavated three burrows in August and September in Kırıkkale province. According to our observations the burrow has 3 to 5 entrances that are about 7 cm in diameter and it descends at an angle 30° to 45° to a depth of 30 cm. The complex burrow of *M. tristrami* extends about 6 to 10 m underground; there are one or two nest chambers about 8 cm in diameter and a food storage chamber about 10 cm in diameter. The nest chambers contain dried vegetation, shredded paper, and other refuse (Figure 2).

Fur colour: The dorsal colour varies from reddish-brown tinged slightly greyish-yellow to reddish-brown with a somewhat greyish tone. The ventral colour varies from dirty white to dirty white to tinged yellow. The dorsal colour of the tail is the same as that of the dorsal up to the tuft, and there is an indistinct pale greyish-black line. The tuft makes up 1/3 the length of the tail and is black. The ventral colour of the tail is pale light brown or light brown.

Feeding: In general, two different types of food were found in the stomach contents of *Meriones tristrami*: plant-based food and animal-based food. We determined that *M. tristrami* eats the vegetal genera *Triticum*, *Hordeum*, *Trifolium*, and *Vitis*, and the animal genus *Formica*.

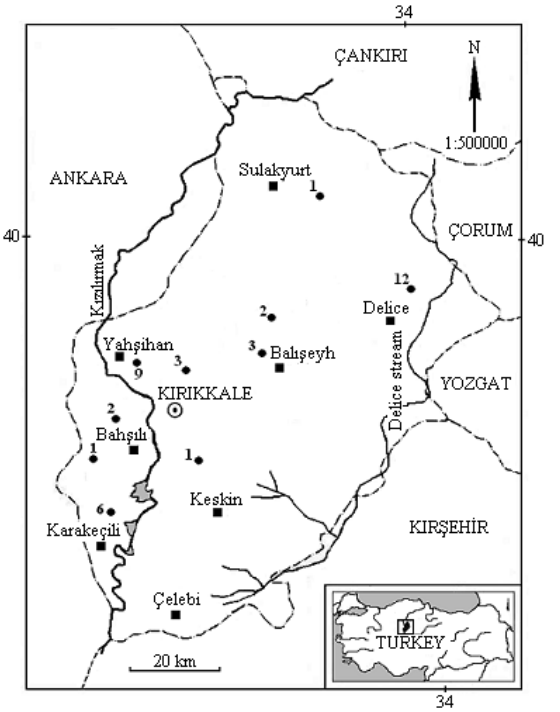


Figure 1. Collection localities (●) of *M. tristrami* in Kırıkkale province (Figures indicate the number of specimens).

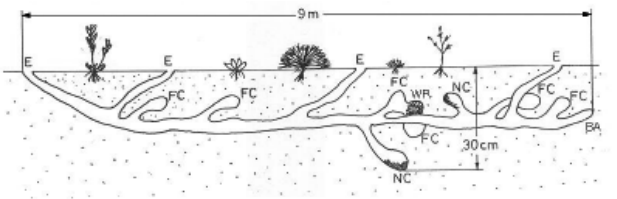


Figure 2. The *M. tristrami* burrow in which two male individuals lived. E: Entrance, FC: Faeces chamber, NC: Nest chamber, WR: Wastage room, BA: Blind alley.

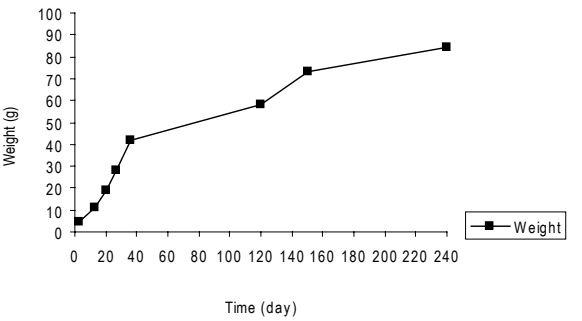


Figure 3. Weight changes in *M. tristrami* young.

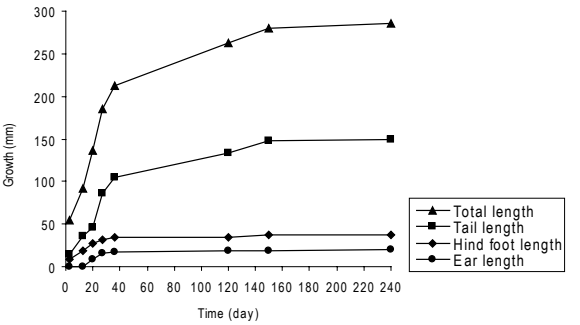


Figure 4. External characters change in *M. tristrami* young.

Breeding: A pregnant animal caught in the middle of April gave birth to 5 young in the laboratory. The eyes and ears of the young were covered by membrane, and their bodies were naked and pink. The scrotums of three animals caught in the middle of May and at the beginning of June were visible. In one of the three female animals caught at the beginning of June, 10 embryos were recorded. Laboratory observation for 240 days provided data for weight and growth curves of young, which are presented in Figures 3 and 4.

Behaviour: *M. tristrami* does not hibernate. A pregnant female and a male animal with visible scrotum were observed in the laboratory. During the daytime, the male lay in the nest, while the female was active. In the middle of April, a pregnant animal gave birth to 5 young. On the 20th day after birth, the young scratched the ground and their incisors were evident. On the 22nd day, they ate sunflower seeds and wheat grains in addition to milk, and competed with one another for food. On the 26th day, a tunnel made by the young was investigated, and three entrances were found. When there was a sound, they used all three entrances to enter the tunnel to hide. Two-month-old subadults fought with each other and some fights resulted in death.

Baculum: Nine baculum specimens were examined from Kırıkkale province. The shape of the baculum is a distinctive feature. The baculum length was 4.4 mm and the breadth of the baculum base was 2.6 mm (Figure 5).

Hair scale form: The scale form was "coronal simple" at the tip of the hair (Figure 6A), and "imbricate flattened" at the shaft (Figure 6B) and at the basal part (Figure 6C).

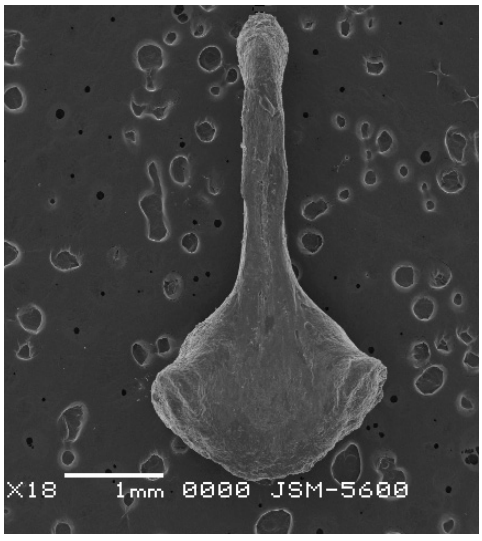
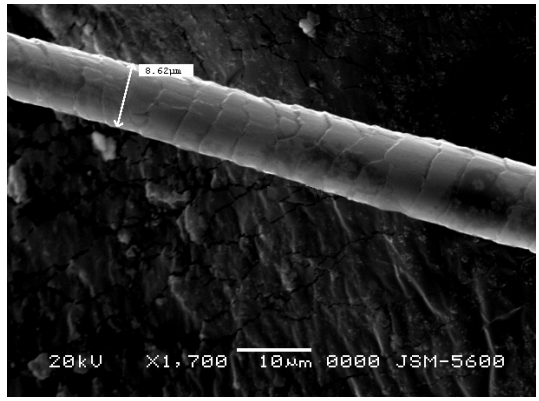
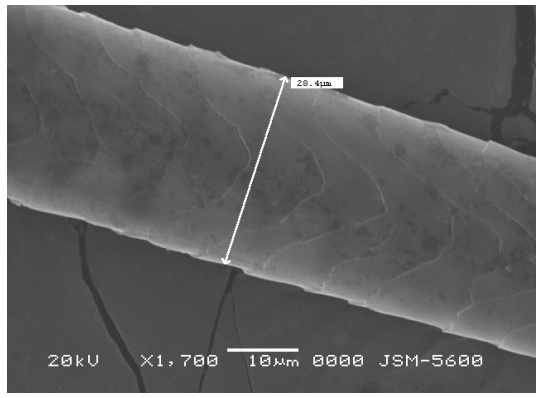


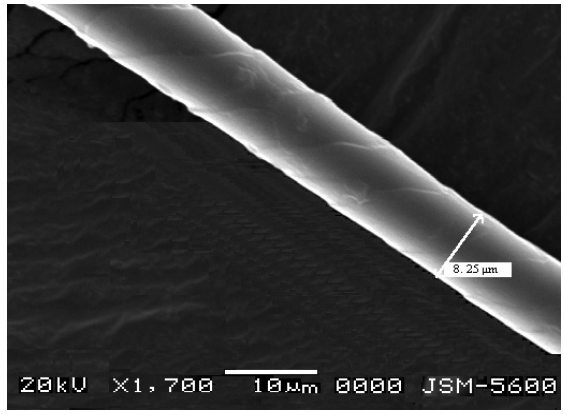
Figure 5. The baculum of *M. tristrami* from Kırıkkale province (dorsal view).



A



B



C

Figure 6. The scale forms in the dorsal hair of *M. tristrami*. Tip (A), shaft (B), and base (C)

Karyology: The karyotype of two *Meriones tristrami* specimens was described from Kırıkkale province. The diploid chromosome number (2n), the fundamental number (FN), and the number of autosomal arms (NFa) were 72, 84, and 80, respectively. The chromosome set consisted of 5 metacentric and submetacentric pairs and 30 acrocentric pairs. The X chromosome was a large metacentric, whereas the Y chromosome was a medium-sized metacentric (Figure 7).

Figure 7. The karyotype of a male *M. tristrami* from Kırıkkale Province.

Measurements: External and cranial measurements and weights of adult, subadult and young specimens are reported in Table 1.

Twenty-one characters were examined for the 3 age groups separately and ANOVA was applied. Statistically it was determined that in each of the 21 tests at least in one of the 3 age groups the relevant character has a different mean. After ANOVA, Bonferroni multiple comparison tests were performed. According to these tests, young and subadults differ in all characters except interorbital breadth; subadults and adults differ in head and body length, occipitonasal length, basal length, diastema length, nasal length, palatina length, length of lower molar alveol, mandible length, mandible height, and weight.

DISCUSSION

Yiğit [9] stated that *Meriones tristrami* lived on the steppes, plains, and field edges. These findings are in accord with the habitat features of *Meriones tristrami* in Kırıkkale province. Our *M. tristrami* specimens' ectoparasites were compared with the ectoparasite data reported by Aktaş [3], Ozsan et al. [7], and Ilikler [8]. The tick species *Ixodes ricinus* and the flea species *Nosopshyllus durii* were determined as ectoparasites of *M. tristrami* in Turkkey for the first time

Ilikler [8] and Yiğit et al. [10] recorded that *Meriones tristrami* used summer and winter burrows and that summer burrows are complex and winter burrows simple. Ilikler [8] noted that there were food storage chambers in the burrows. However, Yiğit et al. [10] stated that there were no food storage chambers in the burrows, but all burrows contained a nest chamber, a wastage room, and a blind alley. Burrows that we excavated had a complex structure and we found a nest chamber, a wastage room, a blind alley, and a few faeces chambers in the burrows. We determined that neither of the burrows contained food storage chambers. Ilikler [8] stated that number and size of nest chambers differ proportionally with the number of individuals living in the burrow and that burrows generally had two nest chambers. These findings are in accordance with ours.

Ilikler [8] indicated that *Meriones tristrami* damaged agricultural crops (such as grain, melon, watermelon, sugar beet, and clover). We found that it ate cultivated plants (grain, melon, watermelon, clover, and spinach) in the laboratory. Yiğit et al. [11] recorded that they found numerous antenna, legs, and cuticle pieces of invertebrates and a large centipede (Chilopod) in their stomach contents. In this study, pieces of ants (*Formica* sp.) were found. Yiğit et al. [11] reported that individuals of this species could not tolerate each other and lived alone in burrows. Our findings indicate that they sometimes live together in the same burrow.

Thomas [24] stated that the dorsal colour of *M. t. lycaon* is cinnamon-buff, the ventral colour on the front and hind feet, including hair bases, is white, and the soles of the feet have a naked narrow area from the proximal end to the centre. He recorded whitish patches between the eye and muzzle, behind the eyes, and behind the ears. He also determined that, except

Table 1. Statistical data on external and cranial measurements (mm) and weight (g) of young, subadult and adult (♂♂, ♀♀) of *M. tristrami* from Kırıkkale province; number of individuals (n), range (r), mean (m), standard deviation (±sd).

Characters	Age Groups											
	Young				Subadult				Adult			
	n	r	m	±sd	n	r	m	±sd	n	r	m	±sd
Total length	9	180-250	211	23.3	8	262-290	278.4	10.1	19	270-340	292.8	15.7
Head and body length	9	90-117	103.6	9.5	8	120-132	127	4.8	19	131-175	145.9	11.5
Tail length	9	80-140	107.6	17.7	8	133-160	147.7	11.1	19	138-165	149.6	8.5
Hind foot length	9	30-36	32.7	1.7	9	33-38	36.3	1.7	22	34-41	36.9	1.7
Ear length	9	15-19	16.7	1.3	9	19-22	20.8	1.4	22	19-23	20.8	1.0
Occipitonasal length	2	31-31.1	31.0	0.1	8	36.5-39.2	38.0	1.1	17	38.5-44.3	40.6	1.4
Basal length	2	25-25.1	25.0	0.1	8	29.9-32.2	31.5	0.8	19	30.2-37.4	33.7	1.7
Diastema length	5	7.9-10	8.7	0.8	8	10.0-10.9	10.4	0.3	22	10.3-13.3	11.3	0.6
Nasal length	5	11.4-14	12.4	0.9	8	13.9-15.6	14.8	0.6	20	15.5-18.6	16.5	0.7
Length of upper molar alveol	5	5.1-5.7	5.4	0.1	8	5.8-6.4	6.0	0.2	22	5.9-6.6	6.2	0.2
Length of upper molar row	7	4.5-4.7	4.6	0.1	7	4.8-5.4	5.0	0.2	19	4.9-5.8	5.4	0.3
Bullae length	3	9.3-9.4	9.2	0.1	8	10.5-11.5	10.9	0.3	20	10.8-11.9	11.2	0.1
Interorbital breadth	6	5.6-6.3	5.9	0.2	8	6.0-6.6	6.3	0.2	22	6.0-7.7	6.6	0.3
Occipital breadth	3	9.2-13.9	12.3	2.6	8	15.0-15.5	15.2	0.1	19	15.0-16.9	15.7	0.4
Palatina length	3	13.6-15.8	14.7	1.0	8	16.4-18.5	17.4	0.6	21	17.9-20.0	18.8	0.5
Zygomatic breadth	2	16.2-17	16.6	5	2	21.5-21.6	21.6	0.1	7	21.4-24.3	22.5	1.0
Length of lower molar alveol	9	5.4-5.9	5.6	0.1	8	5.7-6.6	6.1	0.3	22	6.0-6.9	6.4	0.2
Length of lower molar row	6	4.3-4.6	4.5	0.1	7	4.6-5.3	4.9	0.2	22	4.9-5.5	5.2	0.1
Mandible length	9	15.6-18.5	16.3	0.8	8	18.3-20.3	19.3	0.8	22	19.5-24.5	20.9	1.0
Mandible height	9	4.0-4.6	4.3	0.1	8	4.6-5.3	4.9	0.2	22	4.9-6.2	5.4	0.2
Weight	9	27-49	33.6	7.2	9	58-108	78.7	16.2	21	74-157	99.8	18.9

for the last 5 cm, the tail is buffy whitish; the remaining part is blackish. These findings are in accordance with our specimens.

Harrison and Bates [23] recorded that *M. tristrami* breeds throughout the year, and its maximum fertility is between April and September in Israeli. Our findings indicate that individuals do not breed in winter (November and December), and that maximum fertility occurs in May and June. Average litter size of *M. tristrami* was recorded to be 3.2 by Ilikler [8] and 6.3 by Yiğit et al. [10]. We found it to be 7.5 in this study.

Yiğit et al. [10] determined that body hair began to grow after two weeks in May and after a week in December; eyes opened after 19 days in May and after 15 days in December. They also recorded that young are weaned after 1.5 months. According to Ilikler [8], body hair began to grow at 4-5 days, eyes opened at 18-22 days, and young were weaned after 26-35 days. Our findings suggest that body hair begins to grow at 10-11 days, eyes open at 18-19 days, and young are weaned after 28-35 days. In conclusion, it was established that body hair begins to grow at 4-14 days, eyes open at 12-24 days, and young are weaned after 28-45 days.

Yiğit [9] reported 2n=72, NF=82, and NFa=78 in the subspecies *M. t. lycaon*, from Ankara province. The chromosome set consisted of 5 pairs of submetacentric including X and Y, and 31 pairs of acrocentrics. Kefelioğlu [6] recorded that the most commonly seen karyotype of *M. tristrami* in Turkey was 2n=72, NF=84, and NFa=80. Chromosomal data of the specimens obtained from Kırıkkale were in accordance with those reported by Kefelioğlu [6]. In conclusion, dissimilarities in the NFa of *M. tristrami* distributed in Turkey could be due to the differences in the heterochromatin density of the chromosomes.

The specimens from Kırıkkale province were compared to the original description of *Meriones tristrami* reported by Thomas [25]. In our specimens, occipitonasal length, zygomatic breadth, nasal length, and diastema length are greater and bullae length is smaller than in the type specimen. According to the external and cranial measurements of *M. t. lycaon* from Karadağ (Karaman) reported by Thomas [24], our specimens have smaller bullae length and longer head and body length. Based on measurements of *M. t. kilisensis* described from Kilis by Yiğit and Çolak [26], our specimens have smaller zygomatic length, occipitonasal length, and nasal length, and greater lower molar length. The bullae length of *M. t. intraponticus* described from Tosya (Kastamonu) by Neuhäuser [27] is greater than that in our specimens. Yiğit and Çolak [26] also recorded that there was a slight recess on the back of the proximal base of the baculum in *M. t. lycaon*; however, in our specimens there was no recess.

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