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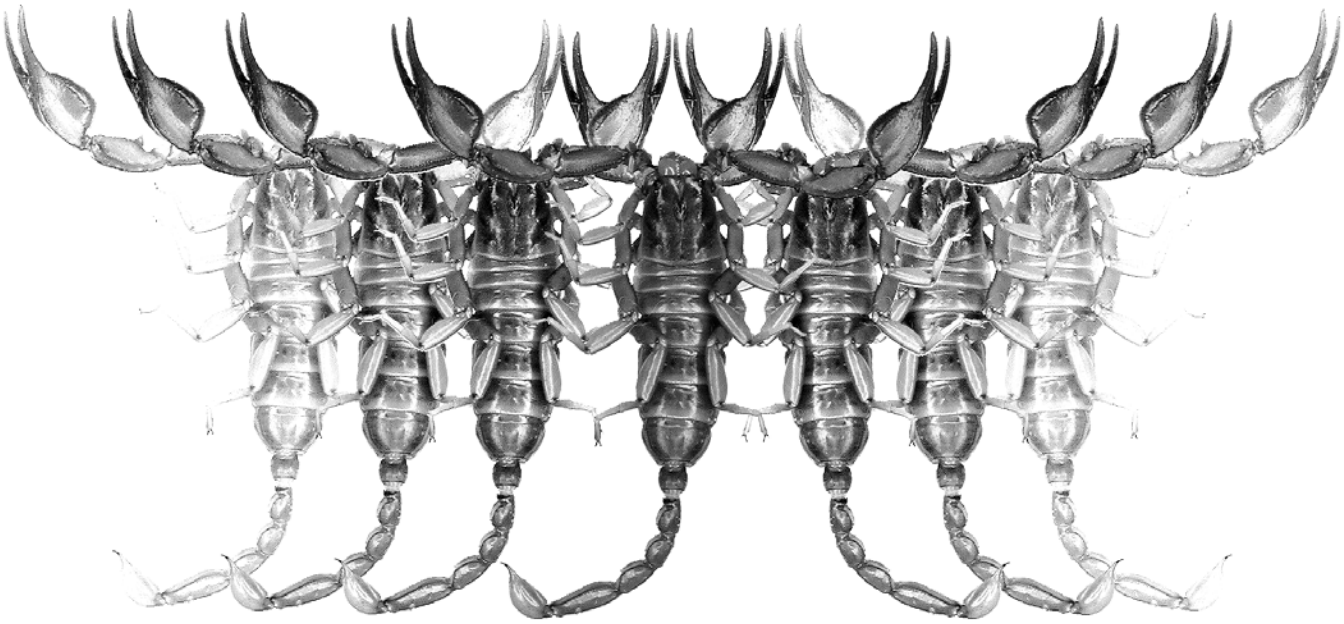

Mesobuthus nigrocinctus (Ehrenberg, 1828) (Scorpiones: Buthidae) in Turkey: Distribution and Morphological Variation

Ayşegül KARATAŞ

April 2007 – No. 56

Euscorpius

Occasional Publications in Scorpiology

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Mesobuthus nigrocinctus (Ehrenberg, 1828) (Scorpiones: Buthidae) in Turkey: Distribution and Morphological Variation

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Summary

Distribution of *Mesobuthus nigrocinctus* is studied and new geographical records are given. As a result of field studies, *M. nigrocinctus* is recorded from 17 confirmed localities from five provinces in Turkey. Comparative statistical analysis of morphology of *M. nigrocinctus* and *M. gibbosus* indicated highly significant differences between these two species. Student's *t*-test analysis and Discriminant Function Analysis (DFA) showed that: (a) while all morphometric ratios demonstrated significant differences between *M. nigrocinctus* and *M. gibbosus* females, only selected ratios show significant difference in the males (Ca_L/W, Ch_L/W, Met-II_L/H, and Met-V_L/H); (b) among *M. nigrocinctus*, Adıyaman population was partly separated; (c) among *M. gibbosus*, females from Kahramanmaraş population significantly differed from females of all other populations in selected ratios (Ca_L/W, Met-I_L/H, Met-I_L/H, Met-V_L/W, and Met-V_L/H) while no such significant difference was found in the males. In males, classification results of DFA show that all specimens from Kahramanmaraş Province were separated, and situated in distinct areas of the graph relative to its vertical axis. These specimens grouped closer to *M. gibbosus* than to *M. nigrocinctus*.

Introduction

The genus *Mesobuthus* Vachon, 1950 (Scorpiones, Buthidae) currently includes 14 species that occur in the Palaearctic Region from the Balkans to Korea (Fet et al., 2000; Gantenbein et al., 2000; Lourenço et al., 2005). Four of these species have been recorded in Turkey: *Mesobuthus caucasicus* (Normann, 1840), *M. eupeus* (C.L. Koch, 1839), *M. gibbosus* (Brullé, 1832), and *M. nigrocinctus* (Ehrenberg, 1828) (Vachon, 1947a, 1947b; Tolunay, 1959; Kinzelbach, 1984, 1985; Vachon & Kinzelbach, 1987; Kovařík, 1998; Fet et al., 2000; Gantenbein et al., 2000; Karataş & Karataş, 2001, 2003; Teruel, 2002; Karataş, 2005; Karataş & Çolak, 2005).

Of these species, *M. nigrocinctus* was first described as *Androctonus* (*Prionurus*) *nigrocinctus* Ehrenberg, 1828 from the mountains near Beirut (Lebanon). Fet et al. (2000) redescribed *M. nigrocinctus* from Mt. Hermon as a new combination, comparing to *M. gibbosus* (Fet et al., 2000). In Turkey, *M. nigrocinctus* has been recorded from Adıyaman and Gaziantep Provinces (Southeastern Turkey) by Crucitti & Vignoli (2002) and Karataş & Çolak (2005), respectively. Although *M. nigrocinctus* was listed several times from Turkey, distributional and morphological information about this species has been insufficient.

On the other hand, Kinzelbach (1984) recorded *Mesobuthus* from Kahramanmaraş Province under question as *M. caucasicus* as questionable; at that time *M. nigrocinctus* has not been redescribed.

This study has been done in order to determine the intra- and interspecific morphological variation in two *Mesobuthus* species found in Turkey, *M. nigrocinctus* and *M. gibbosus*. Additionally, we compared morphology of *Mesobuthus* populations from Kahramanmaraş with *M. nigrocinctus* and *M. gibbosus* from different localities in Anatolia.

Material and Methods

Scorpions were collected under stones during the day time and placed into 70% ethanol. Specimens were deposited in the scorpion collection at Zoology Department of Niğde University (ZDNU-S). Measurements were taken with > 0.1 mm accurate micrometric ocular with the stereo-microscope Olympus SZX9. All measurements are in millimeters (mm). Terminology is after Stahnke (1970) and Levy & Amitai (1980).

Mesobuthus gibbosus specimens used in this study as comparative material were chosen along the whole range of the species in Turkey to make comparison homogeneous. The specimens of *M. gibbosus* were

collected from7 Adana, Adıyaman, Ankara, Antalya, Balıkesir, Hatay, İzmir, Kahramanmaraş, Kırıkkale, Konya, Manisa, Mersin, Muğla, Nevşehir, Niğde, and Osmaniye Provinces.

Statistical analysis was conducted using SPSS 13.0 for Windows. Measurements of 14 characters in each group of males and females of *M. nigrocinctus* and *M. gibbosus* were used in the morphometric analysis. The univariance analysis included descriptive statistics (means and standard deviations [SD]) for each variable (Table 1) and Student's unpaired t-test analysis were used to determine the morphological measurements which have significant differences between *M. nigrocinctus* and *M. gibbosus* (Table 2). The multivariate DFA (Discriminant Function Analysis) was also conducted using SPSS software.

Abbreviations of morphometric ratios

Ca_L/W: carapace length to width; Fem_L/W: pedipalp femur length to width; Pat_L/W: pedipalp patella length to width; Ch_L/W: pedipalp chela length to width; Met-I_L/W: metasomal segment I length to width; Met-I_L/H: metasomal segment I length to height; Met-II_L/W: metasomal segment II length to width; Met-II_L/H: metasomal segment II length to height; Met-III_L/W: metasomal segment III length to width; Met-III_L/H: metasomal segment III length to height; Met-IV_L/W: metasomal segment IV length to width; Met-IV_L/H: metasomal segment IV length to height; Met-V_L/W: metasomal segment V length to width; Met-V_L/H: metasomal segment V length to height; n = sample size.

Specimens examined

Mesobuthus nigrocinctus* (Ehrenberg, 1828).** Total 41 specimens (27 ♀♀, 14 ♂♂): ***Adıyaman Province: Nemrut Mountain (1550 m asl), 21.IX.2002: 1 ♀ (ZDNU-S 2002/66.1), ibid., on the road to TRT radio-link (1630 m asl), 22.IX.2002: 1 ♀, 1 sad. ♂ (ZDNU-S 2002/67.1-2), ibid., near TRT station, 03.IX.2004: 1 sad. ♀ (ZDNU-S 2004/85), 04.IX.2004: 1 ♀ (ZDNU-S 2004/92), 19.VIII.2004: 1 ♂ (ZDNU-S 2004/80), Kâhta, Alidam Village, 20.VIII.2004: 1 ♂ (ZDNU-S 2004/86), Karadut Village, 12.VIII.2004: 1 ♀ (ZDNU-S 2004/81), 07.VIII.2004: 1 ♀ (ZDNU-S 2004/91), Upper parts of Karadut Village, 21.IX.2002: 1 ♀ (ZDNU-S 2002/57), Horik Village, 09.VIII.2004: 1 ♀ (ZDNU-S 2004/93), 10.VIII.2004: 1 ♀ (ZDNU-S 2004/89), Damlacık Village, 27.VIII.2004: 1 ♂ (ZDNU-S 2004/87), Narince, 24.VIII.2004: 1 ♂ (ZDNU-S 2004/88), Gölbaşı, Çataltepe, 15.V.2005: 1 sad. ♂ (ZDNU-S 2005/2.1), 15.VII.2001: 1 ♂ (ZDNU-S 2001/75). ***Erzincan Province***: Kemaliye, 15.VI.2000: 1 ♀ (ZDNU-S 2000/15), 16.VI.2000: 1 ♀ (ZDNU-S 2000/2), 17.VII.2000: 1 ♀ (ZDNU-S 2000/6). ***Gaziantep Province***: Şahinbey, Karataş, Budak Town, 13.VII. 2003: 1 ♀ (ZDNU-S 2003/466), Şahinbey, Karataş, 29.VI.2003: 1 ♀ (ZDNU-S 2003/522), Nizip, Mağaracık Village (460 m asl), 27.IX. 2002: 1 ♀ (ZDNU-S 2002/357), on road from Gaziantep to Nizip, 12.VIII. 2001: 2 ♀♀, 2 ♂♂ (ZDNU-S 2001/292.1-4), Hatay: Antakya, Şenköy, 21.VIII.2001: 2 ♂♂ (ZDNU-S 2001/51.1-2), Belen, Sarımazı, 15.IV.2006: 6 ♀♀, 2 ♂♂ (ZDNU-S 2006/132.1-8). ***Malatya Province***: Eski Malatya (Battalgazi), 08.VI.2004: 1 ♀ (ZDNU-S 2004/94), Darende, 07.VI.2005: 2 ♀♀ (ZDNU-S 2005/29.1-2), Hekimhan, Aşağıgirmana Village, 14.V. 2001: 1 ♀, 1 ♂ (ZDNU-S 2001/113).

***Mesobuthus gibbosus* (Brullé, 1832).** Total 42 specimens (20 ♀♀, 22 ♂♂): **Adana Province:** Kozan, Kabaktepe [1], 29.IX.2002: 2 ♂♂ (ZDNU-S 2002/81.1-2). **Adıyaman Province:** Gölbaşı, Çataltepe [2], 15.V.2005: 1 ♀ (ZDNU-S 2005/2.2). **Ankara Province:** Şereflikoçhisar [9], 21.VIII.2003: 1 ♀ (ZDNU-S 2003/165). **Antalya Province:** Alanya, Çakallar Village [10], 08.VII.1998: 1 ♀ (ZDNU-S 1998/1). **Balıkesir Province:** Edremit, İdaköy [11], 28.VIII.2005: 1 ♀ (ZDNU-S 2005/112), Havran, İnönü Village, İnboğazı [12], 25.VIII.2005: 2 ♂♂ (ZDNU-S 2005/114.1-2). **Hatay Province:** Belen, Sarımazı [19], 15.IV.2006: 1 ♀ (ZDNU-S 2006/133). **İzmir Province:** Çiğli, Egekent [20], 28.VIII.2003: 1 ♂ (ZDNU-S 2003/172). **Kahramanmaraş Province:** Güzlek Bağları [21], 25.IX.2002: 1 ♀, 2 ♂♂ (ZDNU-S 2002/49.1-3), Döngel Village (near Döngel Cave) [22], 26.VIII.1999: 1 ♀ (ZDNU-S 1999/4), Afşin [23], 05.IX.2002: 2 ♀♀, 2 ♂♂ (ZDNU-S 2002/92.1-4), 18.VI.2003: 2 ♂♂ (ZDNU-S 2003/11.1-2), Emirli Village [24], 03.VIII.2002: 2 ♂♂ (ZDNU-S 2002/88.1-2). **Kırıkkale Province:** Kimeski Quarter [25a], 19.VII.2003: 1 ♂ (ZDNU-S 2003/178), Yeni Quarter [25b], 08.VIII.2003: 1 ♂ (ZDNU-S 2003/176). **Konya Province:** Doğanhisar, Başköy, Ardıçtepe [26], 21.VIII.2001: 2 ♀♀ (ZDNU-S 2001/118.1-2). **Manisa Province:** Horozköy [30], 20.VIII.2002: 1 ♀ (ZDNU-S 2002/96), Akhisar, Moralılar Village [31], 07.VII.2002: 1 ♂ (ZDNU-S 2002/95). **Mersin Province:** between Anamur-Aydıncık [32], 21.II.1998: 1 ♀ (ZDNU-S 1998/7). **Muğla Province:** Ortaca (Dalyan), Gökbel Village [33], --.II.1999: 1 ♂ (ZDNU-S 1999/14). **Nevşehir Province:** Derinöz [34], 30.VII.2003: 1 ♂ (ZDNU-S 2003/217), Avanos, Bozca Village [35], 07.VIII.2003: 1 ♀ (ZDNU-S 2003/203), road Nevşehir to Avanos, Emeksiz [36], 08.VIII.2003: 1 ♂ (ZDNU-S 2003/204), Zelve, Aktepe Village [37], 27.V.2001: 1 ♀ (ZDNU-S 2003/206). **Niğde Province:** centrum [38a], 20.V.2000: 1 ♀ (ZDNU-S 2000/9), Kayabaşı Quarter [38b], 07.VIII.2003: 1 ♂ (ZDNU-S 2003/23), near K.Y.K. Hostels [40], 27.V.2001: 1 ♀ (ZDNU-S 2001/61.1), between Fertek and Koyunlu [41], 17.VIII

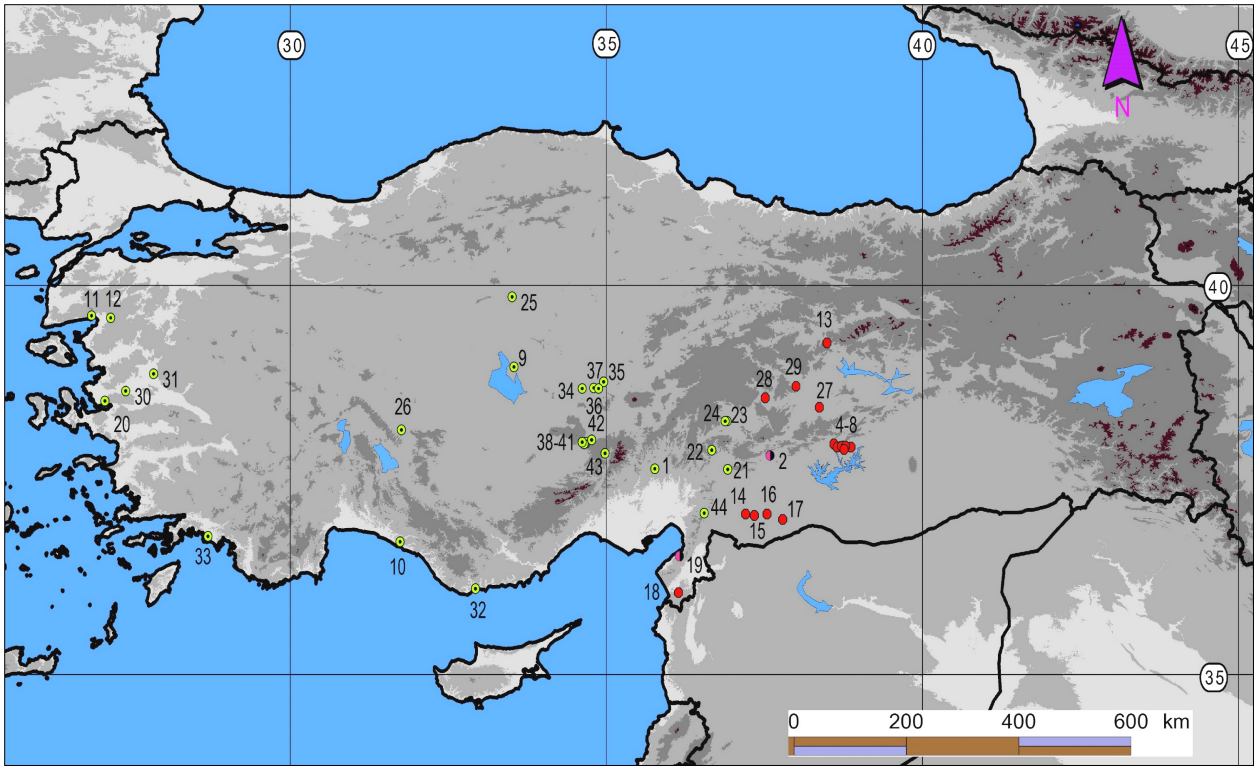

Figure 1: Sampling localities of *Mesobuthus nigrocinctus* (●), *M. gibbosus* (◉), and syntopic sites (◑). Locality numbers are shown in the text.

.2003: 1 ♂ (ZDNU-S 2003/162), near Gümüşler Lakelet [42], 15.IX.2004: 2 ♀♀ (ZDNU-S 2004/48.1-2), Çamardı [43], 15.V.2004: 1 ♀ (ZDNU-S 2004/21). **Osmaniye Province:** Hasanbeyli, Almanpınarı High Plateau [44], 22.VIII.2005: 1 ♂ (ZDNU-S 2005/115).

Results

Mesobuthus nigrocinctus (Ehrenberg, 1828)

Mesobuthus nigrocinctus (Fig. 4) was collected from Adıyaman, Gaziantep, Hatay, Erzincan, and Malatya Provinces (Fig. 1). *M. nigrocinctus* was found sympatrically with *Mesobuthus eupeus*, *Androctonus crassicauda*, *Leiurus quinquestriatus*, *Compsobuthus matthiesseni*, *Scorpio maurus*, and *Calchas nordmanni* in Gaziantep Province (see also Karataş & Çolak, 2005); with *M. gibbosus*, *M. eupeus*, *L. quinquestriatus*, *C. matthiesseni*, and *Calchas nordmanni* in Adıyaman; with *M. gibbosus*, *M. eupeus*, *L. quinquestriatus*, and *S. maurus* in Hatay; with *M. eupeus* and *C. nordmanni* in Malatya; and with *M. eupeus* in Erzincan. According to these findings, *M. nigrocinctus* was sympatric with *M. gibbosus* in Adıyaman and Hatay (see also Fig. 1). The northernmost distribution of *M. nigrocinctus* reaches to Erzincan Province, and the easternmost distribution of *M. gibbosus* reaches to Adıyaman Province (based on our present knowledge).

Morphological variation within populations

In females, the mean ratio of all measurements is larger in *M. nigrocinctus* than those of *M. gibbosus* with the exception of Ca_L/W, and the mean ratio of all measurements of Adıyaman group is larger than those from Malatya, Gaziantep, Hatay and Erzincan groups. A "larger" ratio in this context implies a thinner segment. According to t-test analysis all measured characters show significant difference between females of *M. nigrocinctus* and *M. gibbosus* (Table 2).

The mean ratios of Ch_L/W and Fem_L/W are larger in Kahramanmaraş specimens than those of *M. gibbosus* collected from different regions, but the mean ratio of all other measurements are smaller in Kahramanmaraş specimens either than *M. gibbosus* or *M. nigrocinctus* groups (Table 1). Only certain characters (Ca_L/W, Met-I_L/W, Met-I_L/H, Met-V_L/W and Met-V_Seg. L/H) show significant difference between *M. gibbosus* collected from Kahramanmaraş and those collected from different regions (Table 6).

In males of *M. nigrocinctus* from Adıyaman, mean ratios of all measurements are larger than those from Malatya, Gaziantep, Hatay and Erzincan (Table 3). Only mean ratios of the following characters: Ca_L/W, Ch_L/W, Met-II_L/H, and Met-V_L/H, have significant difference between males of *M. nigrocinctus* and *M.*

Character	*Mesobuthus nigrocinctus*				*Mesobuthus gibbosus*		
	Malatya (n= 4)	Gaziantep (n= 5)	Adıyaman (n= 9)	Hatay (n= 6)	Erzincan (n= 3)	Kahramanmaraş (n=4)	Different localities (n=16)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Ca_L/W	1.82 ± 0.11	1.99 ± 0.01	1.92 ± 0.06	1.84 ± 0.04	1.91 ± 0.00	1.51 ± 0.09	1.74 ± 0.21
Fem_L/W	3.23 ± 0.09	3.15 ± 0.02	3.28 ± 0.07	3.25 ± 0.14	3.27 ± 0.05	3.14 ± 0.22	3.10 ± 0.24
Pat_L/W	2.78 ± 0.06	2.71 ± 0.14	3.08 ± 0.31	2.88 ± 0.23	2.90 ± 0.08	2.60 ± 0.15	2.75 ± 0.15
Ch_L/W	5.53 ± 0.20	5.80 ± 0.57	6.14 ± 0.36	5.42 ± 0.38	5.60 ± 0.33	5.40 ± 0.29	4.94 ± 0.85
Met_I_L/W	1.15 ± 0.06	1.08 ± 0.05	1.14 ± 0.07	1.08 ± 0.04	1.13 ± 0.04	1.02 ± 0.01	1.04 ± 0.05
Met_I_L/H	1.24 ± 0.02	1.25 ± 0.05	1.31 ± 0.07	1.20 ± 0.06	1.28 ± 0.03	1.13 ± 0.01	1.16 ± 0.06
Met_II_L/W	1.43 ± 0.05	1.31 ± 0.12	1.45 ± 0.03	1.31 ± 0.06	1.42 ± 0.04	1.28 ± 0.01	1.31 ± 0.06
Met_II_L/H	1.48 ± 0.06	1.38 ± 0.11	1.53 ± 0.03	1.38 ± 0.07	1.48 ± 0.01	1.36 ± 0.01	1.36 ± 0.05
Met_III_L/W	1.52 ± 0.05	1.43 ± 0.05	1.56 ± 0.04	1.42 ± 0.08	1.51 ± 0.05	1.37 ± 0.03	1.40 ± 0.05
Met_III_L/H	1.58 ± 0.05	1.53 ± 0.04	1.61 ± 0.03	1.48 ± 0.08	1.61 ± 0.07	1.42 ± 0.03	1.44 ± 0.05
Met_IV_L/W	1.80 ± 0.12	1.72 ± 0.05	1.84 ± 0.07	1.70 ± 0.07	1.81 ± 0.05	1.65 ± 0.02	1.68 ± 0.08
Met_IV_L/H	1.88 ± 0.07	1.76 ± 0.07	1.90 ± 0.05	1.78 ± 0.08	1.91 ± 0.03	1.71 ± 0.05	1.76 ± 0.08
Met_V_L/W	2.37 ± 0.09	2.31 ± 0.04	2.41 ± 0.06	2.28 ± 0.11	2.32 ± 0.03	2.06 ± 0.04	2.18 ± 0.14
Met_V_L/H	2.59 ± 0.03	2.54 ± 0.07	2.60 ± 0.07	2.41 ± 0.11	2.67 ± 0.05	2.35 ± 0.03	2.44 ± 0.10

Table 1: Morphometric measurements of the females of *M. nigrocinctus* and *M. gibbosus*.

Character	*Mesobuthus nigrocinctus* (n= 25)	*Mesobuthus gibbosus* (n= 16)	*t*-test	
	Mean ± SD (min – max)	Mean ± SD (min – max)		
Ca_L/W	1.89 ± 0.08 (1.71 – 2.00)	1.74 ± 0.21 (1.43 – 2.00)	0.015	P < 0.05
Fem_L/W	3.25 ± 0.10 (3.06 – 3.52)	3.10 ± 0.24 (2.80 – 3.62)	0.041	P < 0.05
Pat_L/W	2.92 ± 0.26 (2.53 – 3.54)	2.75 ± 0.15 (2.44 – 2.95)	0.015	P < 0.05
Ch_L/W	5.76 ± 0.48 (4.86 – 6.84)	4.94 ± 0.85 (2.20 – 6.00)	0.002	P < 0.05
Met_I_L/W	1.12 ± 0.06 (1.00 – 1.25)	1.04 ± 0.05 (0.95 – 1.14)	0.000	P < 0.05
Met_I_L/H	1.26 ± 0.07 (1.09 – 1.38)	1.16 ± 0.06 (1.08 – 1.29)	0.000	P < 0.05
Met_II_L/W	1.39 ± 0.09 (1.16 – 1.51)	1.31 ± 0.06 (1.15 – 1.42)	0.002	P < 0.05
Met_II_L/H	1.46 ± 0.09 (1.25 – 1.57)	1.36 ± 0.05 (1.25 – 1.45)	0.000	P < 0.05
Met_III_L/W	1.50 ± 0.08 (1.24 – 1.63)	1.40 ± 0.05 (1.28 – 1.47)	0.000	P < 0.05
Met_III_L/H	1.56 ± 0.08 (1.32 – 1.68)	1.44 ± 0.05 (1.35 – 1.55)	0.000	P < 0.05
Met_IV_L/W	1.78 ± 0.10 (1.55 – 1.94)	1.68 ± 0.08 (1.48 – 1.79)	0.001	P < 0.05
Met_IV_L/H	1.85 ± 0.09 (1.63 – 2.00)	1.76 ± 0.08 (1.57 – 1.88)	0.002	P < 0.05
Met_V_L/W	2.35 ± 0.09 (2.06 – 2.47)	2.18 ± 0.14 (2.03 – 2.61)	0.000	P < 0.05
Met_V_L/H	2.55 ± 0.11 (2.22 – 2.72)	2.44 ± 0.10 (2.32 – 2.61)	0.003	P < 0.05

Table 2: Student unpaired *t*-test analysis of morphometric measurements of the females of *M. nigrocinctus* and *M. gibbosus*.

gibbosus (Table 4). According to t-test analysis, no measured characters has significant difference between males of *M. gibbosus* collected from Kahramanmaraş and collected from different regions (Table 5).

Discriminant Function Analysis (DFA)

Numerical taxonomic analysis of *M. nigrocinctus* and *M. gibbosus* from Turkey was also carried out using 14 standard morphometric rations listed above. DFA was performed for females and males specimens. It was performed on seven groups of scorpion populations for females, and on five groups of scorpion populations for males.

Total variation in DFA for males was explained by four components (Fig. 2). The first discriminant function (DF-1) determined for males separated *M. gibbosus* specimens collected from different localities from *M. nigrocinctus* from Hatay, Gaziantep, and Adıyaman, and explained 77 % of the total variability. The second, third and fourth variants explained the remainder of the variation, 16.3 %, 4.3 % and 2.4 %, respectively. In DFA, 97.1 % of males were correctly classified into their groups. In males, all specimens from Kahramanmaraş Province were separated by DFA classification, and were situated in distinct regions relative to the vertical axis of the plot. However, these specimens were found to be closer to *M. gibbosus* than to *M. nigrocinctus*. *M. nigrocinctus* populations collected from three different localities were situated in the same regions relative to the vertical axis of the plot, but among them, Adıyaman population was partially separated.

DFA of female specimens was explained by six components. DFA of females showed 97.8% correct

Character	*Mesobuthus nigrocinctus*			*Mesobuthus gibbosus*	
	Adıyaman (n=6)	Hatay (n=5)	Gaziantep (n=2)	Kahramanmaraş (n=8)	Different localities (n=14)
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD
Ca_L/W	1.95 ± 0.07	1.81 ± 0.04	1.92 ± 0.01	1.65 ± 0.19	1.67 ± 0.23
Fem_L/W	3.73 ± 0.24	3.58 ± 0.28	3.94 ± 0.06	3.38 ± 0.29	3.59 ± 0.44
Pat_L/W	3.23 ± 0.25	3.06 ± 0.21	3.33 ± 0.03	3.05 ± 0.31	3.09 ± 0.15
Ch_L/W	6.35 ± 0.23	5.66 ± 0.23	5.90 ± 0.21	4.97 ± 0.43	5.11 ± 0.73
Met_I_L/W	1.29 ± 0.10	1.21 ± 0.13	1.41 ± 0.03	1.19 ± 0.07	1.20 ± 0.05
Met_I_L/H	1.47 ± 0.13	1.36 ± 0.13	1.59 ± 0.03	1.31 ± 0.09	1.35 ± 0.06
Met_II_L/W	1.73 ± 0.18	1.46 ± 0.15	1.74 ± 0.07	1.52 ± 0.08	1.50 ± 0.08
Met_II_L/H	1.81 ± 0.20	1.58 ± 0.15	1.90 ± 0.06	1.57 ± 0.12	1.56 ± 0.13
Met_III_L/W	1.78 ± 0.16	1.59 ± 0.20	1.94 ± 0.03	1.65 ± 0.11	1.60 ± 0.11
Met_III_L/H	1.85 ± 0.21	1.74 ± 0.20	2.09 ± 0.06	1.69 ± 0.12	1.69 ± 0.13
Met_IV_L/W	2.11 ± 0.20	1.94 ± 0.23	2.29 ± 0.07	1.95 ± 0.12	1.94 ± 0.13
Met_IV_L/H	2.24 ± 0.31	2.08 ± 0.29	2.53 ± 0.15	2.05 ± 0.12	2.07 ± 0.18
Met_V_L/W	2.70 ± 0.32	2.64 ± 0.22	2.98 ± 0.23	2.41 ± 0.15	2.57 ± 0.22
Met_V_L/H	3.19 ± 0.41	2.99 ± 0.36	3.21 ± 0.25	2.70 ± 0.19	2.82 ± 0.23

Table 3: Morphometric measurements of the males of *M. nigrocinctus* and *M. gibbosus*.

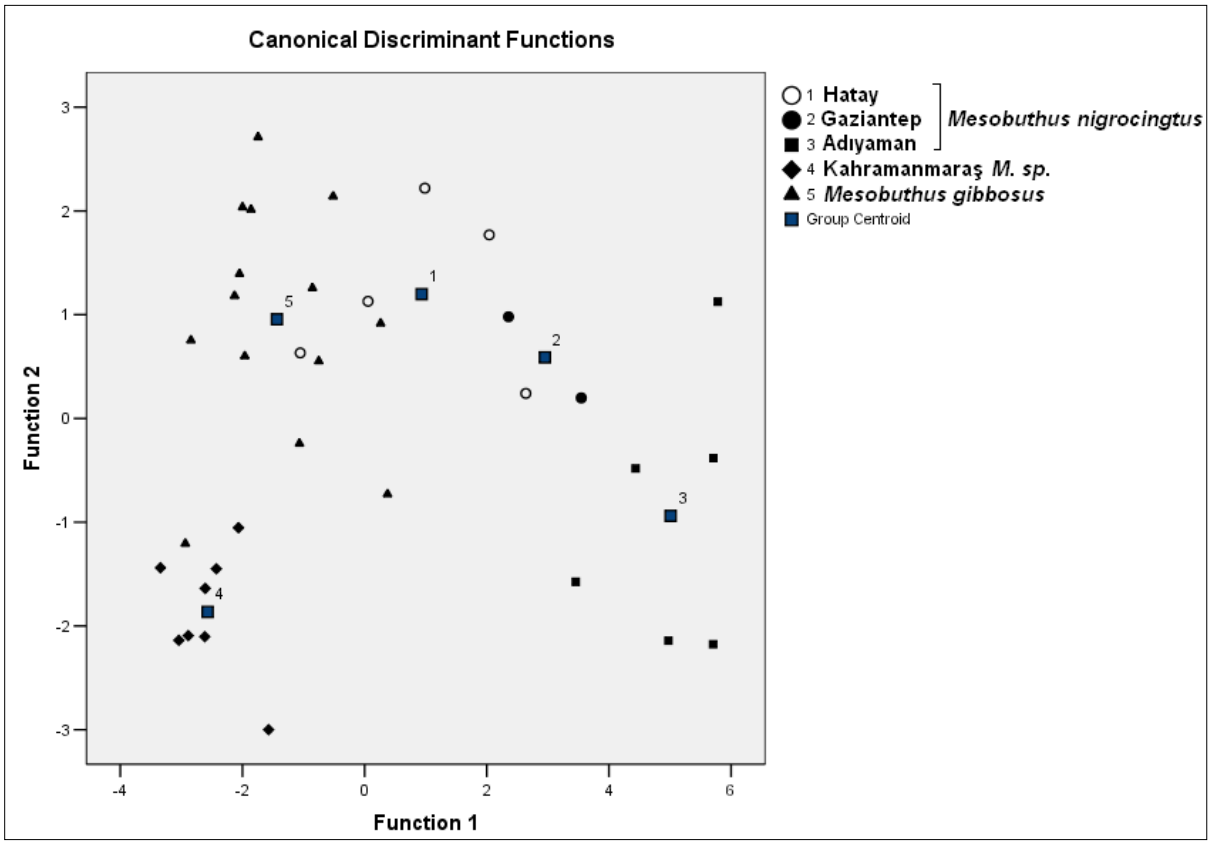

Figure 2: Canonical Discriminant Functions Analysis (DFA) of males of *M. nigrocinctus* and *M. gibbosus* populations.

classification. The first canonical variant explained most of the variation (65.4%). The second, third, and fourth variants explained a majority of the remainder of the variation, 15.6%, 9.0% and 5.2%, respectively. In females, classification results of DFA revealed two different population groups (Fig. 3). These are the population of *M. gibbosus* from Kahramanmaraş Province as opposed to another group that included populations of *M. nigrocinctus* from five different provinces. The specimens from Kahramanmaraş were

Character	*Mesobuthus nigrocinctus* (n= 13)	*Mesobuthus gibbosus* (n= 14)	*t*-test	
	Mean ± SD (min – max)	Mean ± SD (min – max)		
Ca_L/W	1.90 ± 0.08 (1.75 – 2.00)	1.67 ± 0.23 (1.44 – 2.00)	0.004	P < 0.05
Fem_L/W	3.67 ± 0.28 (3.21 – 4.16)	3.59 ± 0.44 (2.77 – 4.30)	0.583	
Pat_L/W	3.17 ± 0.23 (2.75 – 3.59)	3.09 ± 0.15 (2.85 – 3.40)	0.278	
Ch_L/W	5.96 ± 0.43 (5.20 – 6.62)	5.11 ± 0.73 (3.58 – 6.83)	0.002	P < 0.05
Met_I_L/W	1.27 ± 0.12 (1.02 – 1.46)	1.20 ± 0.05 (1.11 – 1.27)	0.082	
Met_I_L/H	1.43 ± 0.15 (1.15 – 1.71)	1.35 ± 0.06 (1.22 – 1.46)	0.071	
Met_II_L/W	1.61 ± 0.21 (1.27 – 2.00)	1.50 ± 0.08 (1.38 – 1.66)	0.096	
Met_II_L/H	1.72 ± 0.21 (1.37 – 2.06)	1.56 ± 0.13 (1.41 – 1.83)	0.031	P < 0.05
Met_III_L/W	1.72 ± 0.20 (1.36 – 2.02)	1.60 ± 0.11 (1.43 – 1.75)	0.090	
Met_III_L/H	1.82 ± 0.23 (1.47 – 2.15)	1.69 ± 0.13 (1.48 – 1.90)	0.081	
Met_IV_L/W	2.06 ± 0.23 (1.63 – 2.42)	1.94 ± 0.13 (1.70 – 2.14)	0.125	
Met_IV_L/H	2.20 ± 0.32 (1.68 – 2.74)	2.07 ± 0.18 (1.70 – 2.32)	0.201	
Met_V_L/W	2.71 ± 0.29 (2.25 – 3.22)	2.57 ± 0.22 (2.17 – 2.90)	0.174	
Met_V_L/H	3.11 ± 0.37 (2.44 – 3.70)	2.82 ± 0.23 (2.34 – 3.07)	0.025	P < 0.05

Table 4: Student unpaired *t*-test analysis of morphometric measurements of the males of *M. nigrocinctus* and *M. gibbosus*.

Character	*Mesobuthus gibbosus* Kahramanmaraş (n= 8)	*Mesobuthus gibbosus* from other regions (n= 14)	*t*-test
	Mean ± SD (min – max)	Mean ± SD (min – max)	
Ca_L/W	1.65 ± 0.19 (1.47 – 2.00)	1.67 ± 0.23 (1.44 – 2.00)	0.811
Fem_L/W	3.38 ± 0.29 (2.91 – 3.75)	3.59 ± 0.44 (2.77 – 4.30)	0.211
Pat_L/W	3.05 ± 0.31 (2.70 – 3.76)	3.09 ± 0.15 (2.85 – 3.40)	0.773
Ch_L/W	4.97 ± 0.43 (4.13 – 5.46)	5.11 ± 0.73 (3.58 – 6.83)	0.596
Met_I_L/W	1.19 ± 0.07 (1.03 – 1.26)	1.20 ± 0.05 (1.11 – 1.27)	0.889
Met_I_L/H	1.31 ± 0.09 (1.08 – 1.37)	1.35 ± 0.06 (1.22 – 1.46)	0.283
Met_II_L/W	1.52 ± 0.08 (1.35 – 1.63)	1.50 ± 0.08 (1.38 – 1.66)	0.669
Met_II_L/H	1.57 ± 0.12 (1.30 – 1.69)	1.56 ± 0.13 (1.41 – 1.83)	0.828
Met_III_L/W	1.65 ± 0.11 (1.39 – 1.76)	1.60 ± 0.11 (1.43 – 1.75)	0.404
Met_III_L/H	1.69 ± 0.12 (1.39 – 1.79)	1.69 ± 0.13 (1.48 – 1.90)	0.976
Met_IV_L/W	1.95 ± 0.12 (1.69 – 2.11)	1.94 ± 0.13 (1.70 – 2.14)	0.833
Met_IV_L/H	2.05 ± 0.12 (1.77 – 2.22)	2.07 ± 0.18 (1.70 – 2.32)	0.797
Met_V_L/W	2.41 ± 0.15 (2.04 – 2.58)	2.57 ± 0.22 (2.17 – 2.90)	0.074
Met_V_L/H	2.70 ± 0.19 (2.26 – 2.86)	2.82 ± 0.23 (2.34 – 3.07)	0.216

Table 5: Student unpaired *t*-test analysis of morphometric measurements of the males of *M. gibbosus* collected from Kahramanmaraş and different localities from Turkey.

grouped into *M. gibbosus* populations. *M. nigrocinctus* populations collected from five different provinces were situated in the same regions in the vertical elongation of the plot, while the specimens from Adıyaman Province were partly separated among *M. nigrocinctus* populations as in the classification results of DFA of males.

Discussion

Fet et al. (2000) redescribed *M. nigrocinctus* and compared it with *M. gibbosus* specimens collected from Macedonia, Greece, and Turkey. They indicated mean values of Ch_L/W 5.04 (n= 1) for females of *M. nigrocinctus* and 4.45 (n= 10) for females of *M. gibbosus*. In our study, 41 *M. nigrocinctus* specimens collected from 17 different localities and 42 *M. gibbosus* specimens collected from 30 different localities in Turkey were evaluated. We established that in Turkish populations of *M. nigrocinctus* and *M. gibbosus* all measured morphometric ratios had significant difference in females. However, for males of *M. nigrocinctus* and *M. gibbosus* significant differences were found only for ratios Ca_L/W, Ch_L/W, Met-II_L/H and Met-V_L/H.

Kinzelbach (1984) recorded, under question, *M. caucasicus* from Kahramanmaraş Province. In our study,

Character	*Mesobuthus gibbosus* from Kahramanmaraş (n=8)	*Mesobuthus gibbosus* from different regions (n=19)	*t*–test	
	Mean ± SD (min – max)	Mean ± SD (min – max)		
Ca_L/W	1.51 ± 0.09 (1.44 – 1.67)	1.72 ± 0.20 (1.43 – 2.00)	0.011	P < 0.05
Fem_L/W	3.14 ± 0.22 (2.90 – 3.41)	3.10 ± 0.22 (2.80 – 3.62)	0.737	
Pat_L/W	2.60 ± 0.15 (2.38 – 2.80)	2.74 ± 0.14 (2.44 – 2.95)	0.048	P< 0.05
Ch_L/W	5.39 ± 0.29 (4.96 – 5.68)	5.12 ± 0.81 (2.20 – 6.00)	0.164	
Met_I_L/W	1.02 ± 0.01 (1.00 – 1.02)	1.04 ± 0.05 (0.95 – 1.14)	0.138	
Met_I_L/H	1.13 ± 0.01 (1.11 – 1.14)	1.16 ± 0.06 (1.08 – 1.29)	0.218	
Met_II_L/W	1.28 ± 0.01 (1.26 – 1.29)	1.30 ± 0.07 (1.11 – 1.42)	0.103	
Met_II_L/H	1.36 ± 0.01 (1.34 – 1.37)	1.37 ± 0.06 (1.25 – 1.50)	0.872	
Met_III_L/W	1.37 ± 0.03 (1.33 – 1.40)	1.40 ± 0.05 (1.28 – 1.47)	0.183	
Met_III_L/H	1.42 ± 0.03 (1.37 – 1.45)	1.44 ± 0.05 (1.35 – 1.55)	0.210	
Met_IV_L/W	1.65 ± 0.02 (1.61 – 1.68)	1.68 ± 0.08 (1.48 – 1.79)	0.359	
Met_IV_L/H	1.71 ± 0.05 (1.66 – 1.78)	1.76 ± 0.09 (1.57 – 1.88)	0.105	
Met_V_L/W	2.06 ± 0.04 (2.03 – 2.12)	2.18 ± 0.13 (2.03 – 2.61)	0.037	P < 0.05
Met_V_L/H	2.35 ± 0.03 (2.32 – 2.39)	2.44 ± 0.10 (2.25 – 2.61)	0.014	P < 0.05

Table 6: Student unpaired *t*-test analysis of morphometric ratios of the females of *M. gibbosus* collected from Kahramanmaraş and different localities from Turkey.

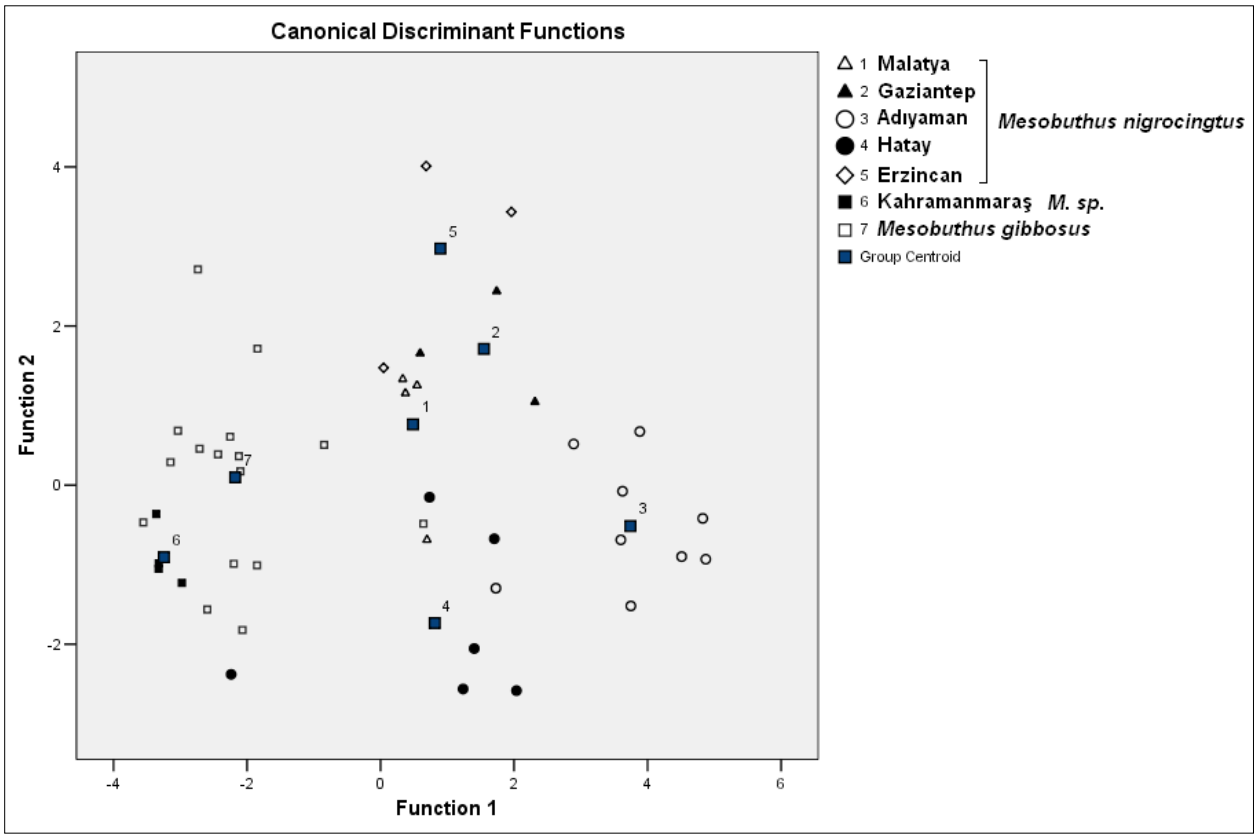

Figure 3: Canonical Discriminant Functions Analysis (DFA) of females of *M. nigrocinctus* and *M. gibbosus* populations.

M. gibbosus specimens collected from Kahramanmaraş were named as *Mesobuthus* sp. and morphometric measurements of these specimens were compared with the measurements of *M. gibbosus* collected from different localities in Turkey. According to *t*-test analysis, no characters had significant mean value differences between males; however, significant differences were detected between females in mean

Figure 4: *Mesobuthus nigrocinctus*, female, Nemrut Mts. (1550 m asl), Kâhta, Adiyaman Province. Photos by Ahmet Karataş.

values of Ca_L/W, Pat_L/W, Met-V_L/W, and Met-V_L/H. According to the present knowledge based on our field studies, only *M. gibbosus* occurs in Kahramanmaraş. Hence, the suspect record of *M. caucasicus* given by Kinzelbach (1984) most likely belongs to *M. gibbosus*. Tolunay (1959) recorded *M. gibbosus* from Erzincan and Tunceli. In the present study, *M. nigrocinctus* was recorded from Erzincan; this species is also recorded as sympatric with *M. gibbosus* in Adıyaman and Hatay Provinces. The *M. gibbosus* record from Tunceli by Tolunay (1959) most likely belongs to *M. nigrocinctus*. The records of Tolunay (1959) should be confirmed by future studies.

Vachon (1947a, 1947b) discussed two zoogeographic territories existing in Turkey, which are separated by the so-called "Anatolian Diagonal" represented by the Antitaurus mountain range located between Trabzon and Hatay. We see that selected characters of certain specimens collected from the Antitaurus region (Kahramanmaraş, Adana, Hatay, Niğde, Osmaniye Provinces) present a mixture of diagnostic features of *M. gibbosus* and *M. nigrocinctus*. These characters refer to the connection of median and posteriomedian carinae on the carapace and the number of oblique granule rows on the pedipalp fingers. Variation in these characters can exhibit asymmetry on the same individual in some specimens from this area. For example, the median and posteriomedian carinae on the carapace may be continuous (as in *M. gibbosus*) on one side, and discontinuous and separated with a small gap (as in *M. nigrocinctus*) on the other. Same situation was found for the number of granular rows on the chela fingers. Number of these rows is 11/12 in *M. gibbosus* and 12/13 in *M. nigrocinctus* on fixed/movable fingers, respectively. However, in some specimens from the Antitaurus, the number of these granules were recorded as 11/12 on one side and 11/13 or 12/13 on another; or 11/13 on both sides. These specimens were not statistically evaluated in this study.

Gantenbein et al. (2000) reported that the specimens of *M. gibbosus* from Central Anatolia were unexpectedly highly differentiated genetically, branching off from the *M. gibbosus* clade at about the same distance level where *Androctonus mauretanicus* separates from other buthids. Specimens from the Antitaurus mentioned above should be analysed genetically and compared to *M. gibbosus* and *M. nigrocinctus*. The phylogenetic relationship of these species should be further investigated, testing a hypothesis that the Antitaurus range could include a secondary contact area between *M. gibbosus* and *M. nigrocinctus*.

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