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. euepis (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 from 7 Adana, Adıyaman, Ankara, Antalya, Balıkesir, Hatay, İzmir, Kahramanmaraş, Kırıkale, 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 univariate analysis included descriptive statistics (means and standard deviations [SD]) for each variable (Table 1) and Student’s unpaired t-test analysis was 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**

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, Androcotus crassicauda, Leturus quinquestriatus, Compsobuthus matthiesseni, Scorpio mauro, and Calchas nordmanni in Gaziantep Province (see also Karatas & Colak, 2005); with M. gibbosus, M. eupeus, L. quinquestriatus, C. matthiesseni, and Calchas nordmanni in Adıyaman; with M. gibbosus, M. eupeus, L. quinquestriatus, and S. mauro 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.
Discriminant Function Analysis (DFA)

Numerical taxonomic analysis of *Mesobuthus nigrocinctus* and *M. gibbosus* from Turkey was also carried out using 14 standard morphometric ratios 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 Adiyaman, 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 three different localities were situated in the same regions relative to the vertical axis of the plot. However, these specimens were found to be closer to *M. nigrocinctus* that to *M. gibbosus* from Kahramanmaraş. In DFA, 97.8% of females were correctly classified into four components (Fig. 2). The first discriminant function (DF-1) determined for females separated *M. gibbosus* from different regions (Table 5).

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

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

Table 2: Student unpaired t-test analysis of morphometric measurements of the females of *M. nigrocinctus* and *M. gibbosus*.
Table 3: Morphometric measurements of the males of *M. nigrocinctus* and *M. gibbosus*.

<table>
<thead>
<tr>
<th>Character</th>
<th><em>Mesobuthus nigrocinctus</em></th>
<th><em>Mesobuthus gibbosus</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adıyaman (n=6)</td>
<td>Hatay (n=5)</td>
</tr>
<tr>
<td>Ca_L/W</td>
<td>1.95 ± 0.07</td>
<td>1.81 ± 0.04</td>
</tr>
<tr>
<td>Fem_L/W</td>
<td>3.73 ± 0.24</td>
<td>3.58 ± 0.28</td>
</tr>
<tr>
<td>Pat_L/W</td>
<td>3.23 ± 0.25</td>
<td>3.06 ± 0.21</td>
</tr>
<tr>
<td>Ch_L/W</td>
<td>6.35 ± 0.23</td>
<td>5.66 ± 0.23</td>
</tr>
<tr>
<td>Met_I_L/W</td>
<td>1.29 ± 0.10</td>
<td>1.21 ± 0.13</td>
</tr>
<tr>
<td>Met_I_L/H</td>
<td>1.47 ± 0.13</td>
<td>1.36 ± 0.13</td>
</tr>
<tr>
<td>Met_II_L/W</td>
<td>1.73 ± 0.18</td>
<td>1.46 ± 0.15</td>
</tr>
<tr>
<td>Met_II_L/H</td>
<td>1.81 ± 0.20</td>
<td>1.58 ± 0.15</td>
</tr>
<tr>
<td>Met_III_L/W</td>
<td>1.78 ± 0.16</td>
<td>1.59 ± 0.20</td>
</tr>
<tr>
<td>Met_III_L/H</td>
<td>1.85 ± 0.21</td>
<td>1.74 ± 0.20</td>
</tr>
<tr>
<td>Met_IV_L/W</td>
<td>2.11 ± 0.20</td>
<td>1.94 ± 0.23</td>
</tr>
<tr>
<td>Met_IV_L/H</td>
<td>2.24 ± 0.31</td>
<td>2.08 ± 0.29</td>
</tr>
<tr>
<td>Met_V_L/W</td>
<td>2.70 ± 0.32</td>
<td>2.64 ± 0.22</td>
</tr>
<tr>
<td>Met_V_L/H</td>
<td>3.19 ± 0.41</td>
<td>2.99 ± 0.36</td>
</tr>
</tbody>
</table>

**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
Mesobuthus nigrocinctus (n = 13) Mesobuthus gibbosus (n = 14) t-test

Character Mean ± SD (min – max) Mean ± SD (min – max) P
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*.

Mesobuthus gibbosus Kahramanmaraş (n = 8) Mesobuthus gibbosus from other regions (n = 14) t-test

Character Mean ± SD (min – max) Mean ± SD (min – max) P
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,
Table 6: Student unpaired \( t \)-test analysis of morphometric ratios of the females of *M. gibbosus* collected from Kahramanmaraş and different localities from Turkey.

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

\( \Delta \) Malatya  
\( \Delta \) Gaziantep  
\( \circ \) Adıyaman  
\( \bullet \) Hatay  
\( \diamond \) Erzincan  
\( \equiv \) Kahramanmaraş *M. sp.*  
\( \equiv \) *Mesobuthus nigrocinctus*  
\( \equiv \) *Mesobuthus gibbosus*  

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 \( \text{Ca}_{\text{L}}/\text{W} \), \( \text{Pat}_{\text{L}}/\text{W} \), \( \text{Met-V}_{\text{L}}/\text{W} \), and \( \text{Met-V}_{\text{L}}/\text{H} \). According to the present knowledge based on our field studies, only \( M. \text{gibbosus} \) occurs in Kahramanmaraş. Hence, the suspect record of \( M. \text{caucasicus} \) given by Kinzelbach (1984) most likely belongs to \( M. \text{gibbosus} \). Tolunay (1959) recorded \( M. \text{gibbosus} \) from Erzincan and Tunceli. In the present study, \( M. \text{nigrocinctus} \) was recorded from Erzincan; this species is also recorded as sympatric with \( M. \text{gibbosus} \) in Adiyaman and Hatay Provinces. The \( M. \text{gibbosus} \) record from Tunceli by Tolunay (1959) most likely belongs to \( M. \text{nigrocinctus} \). 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 \( M. \text{gibbosus} \) and \( M. \text{nigrocinctus} \). These characters refer to the connection of median and posterior median 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 posterior median carinae on the carapace may be continuous (as in \( M. \text{gibbosus} \)) on one side, and discontinuous and separated with a small gap (as in \( M. \text{nigrocinctus} \)) 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 \( M. \text{gibbosus} \) and 12/13 in \( M. \text{nigrocinctus} \) 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 \( M. \text{gibbosus} \) from Central Anatolia were unexpectedly highly differentiated genetically, branching off from the \( M. \text{gibbosus} \) 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 \( M. \text{gibbosus} \) and \( M. \text{nigrocinctus} \). The phylogenetic relationship of these species should be further investigated, testing a hypothesis that the Antitaurus range could include a secondary contact area between \( M. \text{gibbosus} \) and \( M. \text{nigrocinctus} \).

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References


LOURENÇO, W. R., J.-X. QI & M.-S. ZHU. 2005. Description of two new species of scorpions from China (Tibet) belonging to the genera Mesobuthus Vachon (Buthidae) and Heterometrus Ehrenberg (Scorpionidae). Zootaxa, 985: 1–16.


