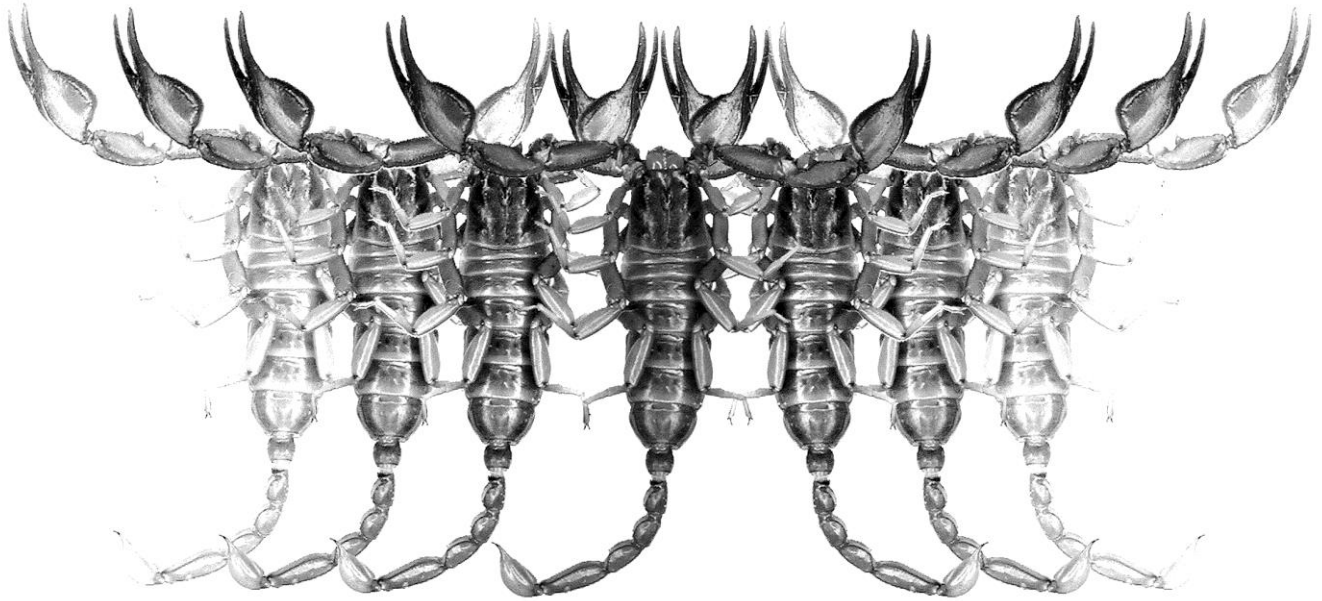


# *Euscorpius*

Occasional Publications in Scorpiology



**A Revision of the Anatolian-Caucasian “*Euscorpius mingrelicus*  
Complex” (Scorpiones: Euscorpiidae)**

**Gioele Tropea, Ersen Aydın Yağmur & Victor Fet**

**July 2015 — No. 203**

# *Euscorpius*

## Occasional Publications in Scorpiology

EDITOR: Victor Fet, Marshall University, 'fet@marshall.edu'  
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**Publication date: 13 July 2015**

<http://zoobank.org/urn:lsid:zoobank.org:pub:BD5EFA22-1FBA-4567-B34B-2B14257AC5DB>

## A revision of the Anatolian-Caucasian “*Euscorpius mingrelicus* complex” (Scorpiones: Euscorpiidae)

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<http://zoobank.org/urn:lsid:zoobank.org:pub:BD5EFA22-1FBA-4567-B34B-2B14257AC5DB>

### Summary

The taxonomic status of the Anatolian-Caucasian subspecies of *Euscorpius mingrelicus* (Kessler, 1874) is reconsidered. We restrict *E. mingrelicus* s.str. to Georgia and Turkey, and elevate to species status three of its subspecies: *E. phrygius* Bonacina, 1980, **stat. n.**, *E. uludagensis* Lacroix, 1995, **stat. n.**, and *E. ciliciensis* Birula, 1898, **stat. n.** We synonymize *E. mingrelicus legrandi* Lacroix, 1995 with *E. phrygius* **stat. n.**, and *E. m. ollivieri* Lacroix, 1995, with *E. mingrelicus*.

### Introduction

Since *Euscorpius mingrelicus* was described by Kessler (1874) from Georgia (thus in the Russian Empire), this species has raised many doubts about its validity. Various authors placed it in synonymy of *E. germanus* (C. L. Koch, 1837) or its subspecies.

Birula (1896) synonymized with *E. mingrelicus* the species *E. picipes* Simon, 1878, described from the western Caucasus (now Georgia). Shortly after that, Birula (1898) described *Euscorpius ciliciensis* from the Taurus Mountains (southern Turkey). Later, Birula (1900, 1917a, 1917b) redescribed *E. mingrelicus* (correcting the number of ventral patellar trichobothria from 5, as originally reported by Kessler, to 6). Birula (1917a, 1917b) compared *E. mingrelicus* with *E. germanus*, considering these two species clearly distinct from each other, and from *E. ciliciensis*. He noted, however, that “despite the characteristic features which differentiate *Eusc. mingrelicus* from *Eusc. germanus*, many specialists have not found it necessary to distinguish between these two forms even as separate geographic races” (Birula, 1917b: 201). This situation persisted for the next century.

Di Caporiacco (1950) considered both *E. mingrelicus* and *E. ciliciensis* to be subspecies of *E. germanus*; however, he did not examine any specimens. Kinzelbach (1975, 1982) continued to treat *E. mingrelicus* as a subspecies of *E. germanus*.

A detailed revision of “*Euscorpius germanus*” was published by Bonacina (1980). He examined numerous specimens from Italy to Turkey, and utilizing new diagnostic characters (the shape of pectinal sensilla, and the fixed finger trichobothrial distance ratio *et-est* / *est-dsb*), separated *E. germanus* and *E. mingrelicus* as two valid species. In addition, Bonacina (1980) also described *E. mingrelicus phrygius* from northwestern Turkey, and placed a number of Balkan forms as subspecies into *E. mingrelicus*. After Bonacina (1980) confirmed the species status for *E. mingrelicus* its scope and distribution remained uncertain.

Fet (1985), prompted by Bonacina’s work, examined specimens of *E. ciliciensis* from Birula’s collection in ZISP (seven specimens, including the two syntypes). He suggested that it is “a transitional form belonging to a ‘complex’ of *E. germanus* / *E. mingrelicus*”, reporting its mean *et-est* / *est-dsb* ratio as 1.39. Subsequently, Fet (1989) listed this form as a subspecies of *E. mingrelicus*. Later, Fet (1993) examined the largest available series of *E. mingrelicus* from the Caucasus (685 specimens), reporting trichobothrial and pectinal teeth statistics as well as mean *et-est/est-dsb* ratio (1.81).

Lacroix (1995) described three new subspecies of *E. mingrelicus* from Turkey: *E. m. legrandi*, *E. m. uludagensis*, and *E. m. ollivieri*, and limited the nomenclotypic subspecies *E. m. mingrelicus* to Georgia.

In the *Catalog of Scorpions of the World*, which included literature up to 1998, Fet & Sissom (2000: 369-372) listed all subspecies of *E. mingrelicus* established

by Bonacina (1980) and Lacroix (1995). They also added *E. m. dinaricus* Di Caporiacco, 1950 from Bosnia as a new combination.

Gantenbein et al. (1999), using DNA markers (16S mtDNA) for the first time in scorpion systematics, established a new subgenus *Alpiscorpius* with type species *E. germanus* (which at that time also included *E. alpha* Di Caporiacco, 1950). Scherabon et al. (2000), also using DNA markers, raised *E. mingrelicus gamma* Di Caporiacco, 1950 to species level, and synonymized with it three subspecies: *E. m. histrorum* Di Caporiacco, 1950, *E. m. caprai* Bonacina, 1980, and *E. m. boninoid* Bonacina, 1980. They also (without a redescription), assigned a neotype for *E. mingrelicus* from Batumi, Georgia, based on a female collected by Fet (1993). At the same time, Fet (2000) described a new species, *Euscorpius beroni*, from Albania, that he considered belonging to “*E. mingrelicus* complex”. Soleglad & Sissom (2001: 30, 90) listed *E. beroni*, *E. gamma*, and *E. mingrelicus* under the subgenus *Alpiscorpius*.

Fet et al. (2004) stated: “*Euscorpius mingrelicus* (Kessler, 1874; type from Georgia) as redefined by Bonacina (1980) and listed by Fet & Sissom (2000), is still under revision. It is now addressed as a ‘*mingrelicus* complex’, which at this moment includes three valid species (*E. gamma* Caporiacco, 1950, *E. beroni* Fet, 2000, and *E. mingrelicus*). The remaining *E. mingrelicus* most likely will be split further... The ‘*mingrelicus* complex’ both in the Balkans and Anatolia is virtually untouched in either morphological or molecular aspects, and requires much more attention.”

Descriptions of the Anatolian-Caucasian subspecies of *E. mingrelicus* by Bonacina (1980) and Lacroix (1995) had few morphological details, and were based mostly on trichobothrial characters. Available molecular marker data are limited: Fet et al. (2003) showed a preliminary DNA phylogeny for two populations of putative *E. ciliciensis*; however, they did not include a sequence of *E. m. mingrelicus* for comparison. Recently, Graham et al. (2012) elevated to the species status an enigmatic *E. germanus croaticus* from Croatia, publishing a DNA phylogeny that included *E. germanus*, *E. alpha*, *E. gamma*, and some populations of “*E. mingrelicus* complex”. However, no detailed revision of this complex has been published, and the status of eight currently valid subspecies of *E. mingrelicus* (listed by Fet et al., 2004: 55) remained unclear.

## Methods and Material

The trichobothrial notation follows Vachon (1974). Morphological measurements are given in millimeters (mm) following Tropea et al. (2014). Morphological nomenclature follows Stahnke (1971), Hjelle (1990), and Sissom (1990); the chela carinae and denticle configuration follows Soleglad & Sissom (2001); and

sternum terminology follows Soleglad & Fet (2003). Terminology concerning *Euscorpius* hemispermaphore anatomy follows Fet et al. (2014). The map was generated using Earth Explorer 6.1.

## Abbreviations

V: trichobothrial series on pedipalp chela manus ventral surface (not including *Et<sub>1</sub>*); Pv: trichobothria on the ventral aspect of pedipalp patella; Pe: trichobothria on the external surface of pedipalp patella; et: external terminal; est: external subterminal; em: external median; esb: external suprabasal; eba: external basal-a; eb: external basal; db: dorsal basal trichobothrium on fixed finger; Dp: pectinal teeth number; L: length; H: height; Lchel: chela length; Wchel: chela width (=Wchel-A of Tropea et al., 2014); Lcar: carapace length; Wcar: carapace width; Lfem: femur length; Lpat: patella length; Lmet: sum of the length of all metasomal segments; Wmet: sum of the width of all metasomal segments; met.seg: metasomal segment; CarA/CarP %: ratio of distances from center of median eyes to anterior and posterior margins of the carapace; DPS: dorsal patellar spur; DD: distal denticle; MD: median denticles; OD: outer denticles; ID: inner denticles; IAD: inner accessory denticles; imm.: immature specimen (at any stage of development).

Depositories: AZMM: Alaşehir Zoological Museum, Celal Bayar University, Alaşehir, Manisa, Turkey; GTC, personal collection of Gioele Tropea, Rome, Italy; MSNB: Museo Civico di Scienze Naturali “E. Caffi”, Bergamo, Italy; MSNV: Museo di Storia Naturale di Venezia, Venice, Italy; MZUR: Museo di Zoologia dell'Università di Roma “Sapienza”, Rome, Italy; NHMW, Naturhistorisches Museum Wien, Vienna, Austria; PAN, Polish Academy of Sciences, Warsaw, Poland; SRSN, Società Romana di Scienze Naturali, Rome, Italy; VFPC: personal collection of Victor Fet, Huntington, West Virginia, USA; ZISP, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia.

## Material Studied

We examined a total of 244 specimens from Turkey and Georgia, covering all the Anatolian-Caucasian subspecies of *E. mingrelicus*, and their entire geographic range. A detailed list of material with label data is provided below under each species. In addition, the third author (Fet, 1993) studied 685 specimens of *E. mingrelicus* from the Caucasus (Georgia and Russia); this work should be consulted for the statistical data on those populations.

Further specimens studied for comparison are listed below:

*E. alpha* Di Caporiacco, 1950: ITALY, Lombardy, Bergamo Province, leg. R. Bianchi, 5 ♂, 4 ♀ (MSNB); Trentino-Alto Adige, Trento, Riva Del Garda, 2012, 1 ♂, 1 ♀ (GTC).

*E. germanus* (C.L. Koch, 1837): ITALY, Belluno, Faverghera Mt., 1 August 2014, leg. Rocen, 2 ♀ (GTC); Udine, Comino, Lago di Comino, 5 September 2014, leg. L. Guariento, 3 ♀ (GTC); Udine, Pradielis, 5 September 2014, leg. U. Devincenzo, 1 ♂, 2 ♀ (GTC); Verona, Malcesine, Baldo Mt., 6 August 2014, leg. L. Guariento, 5 ♀ (GTC); Vicenza, Gallio, Valle di Campomulo, 21 August 2014, leg. U. Devincenzo, 1 ♂, 2 ♀ (GTC); Veneto, Alti Lessini, 1971, leg. M. Paoletti, 1 ♀ (MSNV); Friuli-Venezia Giulia, Ampezzo, cas. Felema, 1200 m, 3 May 1969, leg. M. Paoletti, 2 ♀ (MSNV); Erto, Pordenone, Forcai, 3 ♀ (MSNV); Veneto, Val Tovanello, 18 July 1972, leg. M. Paoletti 1 ♂ (MSNV); Veneto, Campea, Miane, Treviso, 8 October 1972, leg. M. Paoletti, 1 ♀ (MSNV); Veneto, Treviso Hills, March 1969, leg. M. Paoletti, 1 ♀ (MSNV); San Pietro Miane, 13 November 1966, leg. M. Paoletti, 1 ♀ (MSNV); Veneto, Roncavezzari, Folina, 24 May 1970, leg. M. Paoletti, 2 ♂ (MSNV); Veneto, Roncavezzari, 19 June 1971, leg. M. Paoletti, 1 ♀ (MSNV); Friuli-Venezia Giulia, Poffabro, Pordenone, 27 September 1970, leg. M. Paoletti, 1 ♀ (MSNV).

*E. gamma* Di Caporiacco, 1950: CROATIA, between Gospic and Karlobag, 7 August 1971, leg. A. Valle & R. Bianchi, 1 ♂, 5 ♀ (MSNB); between Gospic and Karlobag, 10 August 1970, leg. A. Valle & R. Bianchi, 1 ♂ (MSNB); between Gospic and Karlobag, 17 August 1969, leg. A. Valle & R. Bianchi, 4 ♂, 4 ♀ (MSNB); northern Velebit Mts, 1 July 2000, leg. R. Ozimec, 1 ♀ (GTC); Zrinska Mt., Petrinja, 23 October 2004, leg. R. Ozimec, 1 ♀ (GTC); Varaždin, 8 May 2013, leg. L. Baričević, 1 ♂ (GTC); Zrinska Mt., Sisak-Moslavina, June 2010, leg. N. Gruborović, 1 ♂ (GTC); Zrinska Mt., Sisak-Moslavina, April 2008, leg. T. Kovačević, 1 ♂ (GTC).

*E. sp.* (“*mingrelicus* complex”): Bosnia & Herzegovina / Montenegro border, 5 ♀ (GTC).

## Systematics

### Family Euscorpiidae Laurie, 1896

#### Genus *Euscorpius* Thorell, 1876

#### Subgenus *Alpiscorpius* Gantenbein et al., 1999

#### *Euscorpius phrygius* Bonacina, 1980, stat. n.

(Figs. 1–18, Tables 1–3)

*Euscorpius mingrelicus phrygius* Bonacina, 1980: 72.

Type specimens are deposited in MSNB. Bonacina did not designate a holotype; we designate here the lectotype according to the Article 75 of the ICZN, as

required for the purposes of clarifying the taxonomic status of certain populations.

*Lectotype*: ♂, TURKEY. *Bolu Province*: Abant, 12 August 1972, leg. A. Valle (MSNB 9125).

#### SYNONYMS:

*Euscorpius mingrelicus legrandi* Lacroix, 1995, **syn. n.**

Type specimens, formerly in Lacroix collection, are now deposited in MSNB and NHMW. Lacroix did not designate a holotype; we designate here the lectotype according to the Article 75 of the ICZN.

*Lectotype*: ♂, TURKEY. *Sakarya Province*: Sapanca, 325 m, 10 June 1991, leg. P. Darge (MSNB).

#### REFERENCES:

- Euscorpius mingrelicus phrygius*: Vachon & Kinzelbach, 1987: 100; Fet, 1989: 129; Lacroix, 1991: 21, fig. 98b, d, 100, 108–110, 113, 120–122, 125; Fet, 1993: 5; Lacroix, 1995: 4–6; Fet & Sissom, 2000: 371; Fet et al., 2004: 55; Fet & Soleglad, 2007: 419; Vignoli & Salomone, 2008: 214.
- Euscorpius mingrelicus*: Kritscher, 1993: 387 (in part; Izmit, Abant)
- Euscorpius mingrelicus legrandi*: Lacroix, 1995: 4; Fet & Sissom, 2000: 371; Fet et al., 2004: 55; Fet & Soleglad, 2007: 419.

#### Material examined:

Type material (36 specimens: 12 ♂, 24 ♀).

*Lectotype*: ♂, TURKEY. *Bolu Province*: Abant, 12 August 1972, leg. A. Valle (MSNB 9125).

*Paralectotypes*: same label as lectotype, 9 ♂, 22 ♀, (MSNB 9114–9120, 9122–9126, 9128–9136, 9138–9139, 9141–9144, 9147–9151), 2 ♂, 2 ♀ (GTC).

Other *E. phrygius* stat. n. examined (not type series): (26 specimens: 9 ♂, 17 ♀).

TURKEY. *Ankara Province*: Kızılcahamam, 1100–1200 m, 27–28 May 1967, leg. J. Gruber, G. Pretzmann & F. Ressler, 1 ♂ imm., 2 ♀, 4 ♀ imm. (NHMW 21963); Kızılcahamam District, Göllü area, Soğuksu National Park, 27 May 2009, leg. K.B. Kunt, 2 ♂, 2 ♀ (GTC). *Bolu Province*, Abant, 28 May 2009, leg. K.B. Kunt & A. Kızıltuğ, 1 ♂, 2 ♀ (AZMM); Seben District, Kıbrısık road fork, 40°21'52"N, 31°36'48"E, 25 June 2009, leg. K.B. Kunt & A. Kızıltuğ, 1 ♀ (AZMM); Seben District, Taşlıyayla, 40°27'41"N, 31°31'17" E, 25 June 2009, leg. K.B. Kunt, A. Kızıltuğ, 2 ♀ (AZMM); Mudurnu District, Sülüklü Lake road, 13 April 2013, leg. K.B. Kunt & T. Danışman, 1 ♂ (AZMM); Mudurnu District, Sülüklü Lake road, 14 April 2013, leg. K.B. Kunt & T. Danışman, 2 ♀ (AZMM). *Düzce Province*: Akçakoca, 100 m, March 1990, leg. P. Legrand, 1 ♀ (NHMW 21964; paralectotype of *E. mingrelicus legrandi*); between Konurlap and Akçakoca, 250 m, 15 May 1987, leg. M. Zapparoli, 2 ♀ (MZUR 128, 129);



**Figures 1–2:** *Euscorpium phrygius* stat. n., male lectotype. 1. Dorsal view. 2. Ventral view.

*Karabük Province:* Çankırı, near Eskipazar, 1000 m, 10 October 1982, leg. M. Zapparoli, 2 ♂ (MZUR 74, 75). *Karabük / Bolu Provinces* (a mixed label) “Çankırı, Mengen, Eskipazar”, October 1986, leg. P. Legrand, 1 ♀ imm. (MSNB; paralectotype of *E. m. legrandi*). *Sakarya Province:* Sapanca, 325 m, 10 June 1991, leg. P. Darge, 1 ♂ (MSNB; lectotype of *E. m. legrandi*).

**Geographic range:** Turkey (northwest: Ankara, Bolu, Düzce, Karabük, and Sakarya Provinces) (Fig. 73).

**Diagnosis.** A small *Euscorpium* species, total length 20–27 mm (average 24 mm). Color of adults brown to brown/reddish and dark brown, a darker variegation or marbling on chelicerae, carapace, mesosoma, metasoma and legs is almost always present. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3}+Et_1$ ). The number of trichobothria on the pedipalp patella ventral surface is 6. The number of trichobothria

on pedipalp patella external surface is:  $eb = 4$ ,  $eba = 4$ ,  $esb = 2$ ,  $em = 3$ ,  $est = 4$ ,  $et = 4$ . The pectinal teeth number in males usually is 9, more rarely 8; in females usually 7, more rarely 6. Stocky chela; mean  $Lchel/Wchel$  ratio 2.2 in males and 2.4 in females. Dorsal patellar spur barely developed. Femur usually slightly shorter than patella; mean  $Lfem/Lpat$  ratio 0.93. Carapace approximately as long as wide, tending to be shorter than wide; mean ratio  $Lcar/Wcar$  0.96. Mean ratio of  $Lmet/Lcar$  is 2.77 in males and 2.57 in females. Metasoma is more robust than in other *Euscorpium* species; mean ratio  $Lmet/Wmet$  is 1.37 (range 1.29–1.46). Dorsal metasomal carinae on segments I–IV slightly to well granulated, especially in males. The ventrolateral and ventromedian carinae absent on segments I–IV. The segment V may have granulation variable among specimens; from sparsely present on the distal 2/3 of the carinae to almost completely granulated, so it is difficult to distinguish the carinae. All granulation is more pronounced in males.



**Figures 3–4:** *Euscorpium phrygius* stat. n., female paralectotype. 3. Dorsal view. 4. Ventral view.

***Trichobothrial and pectinal teeth count variation.***

The variation observed in 62 examined specimens (21 ♂, 41 ♀) is given below.

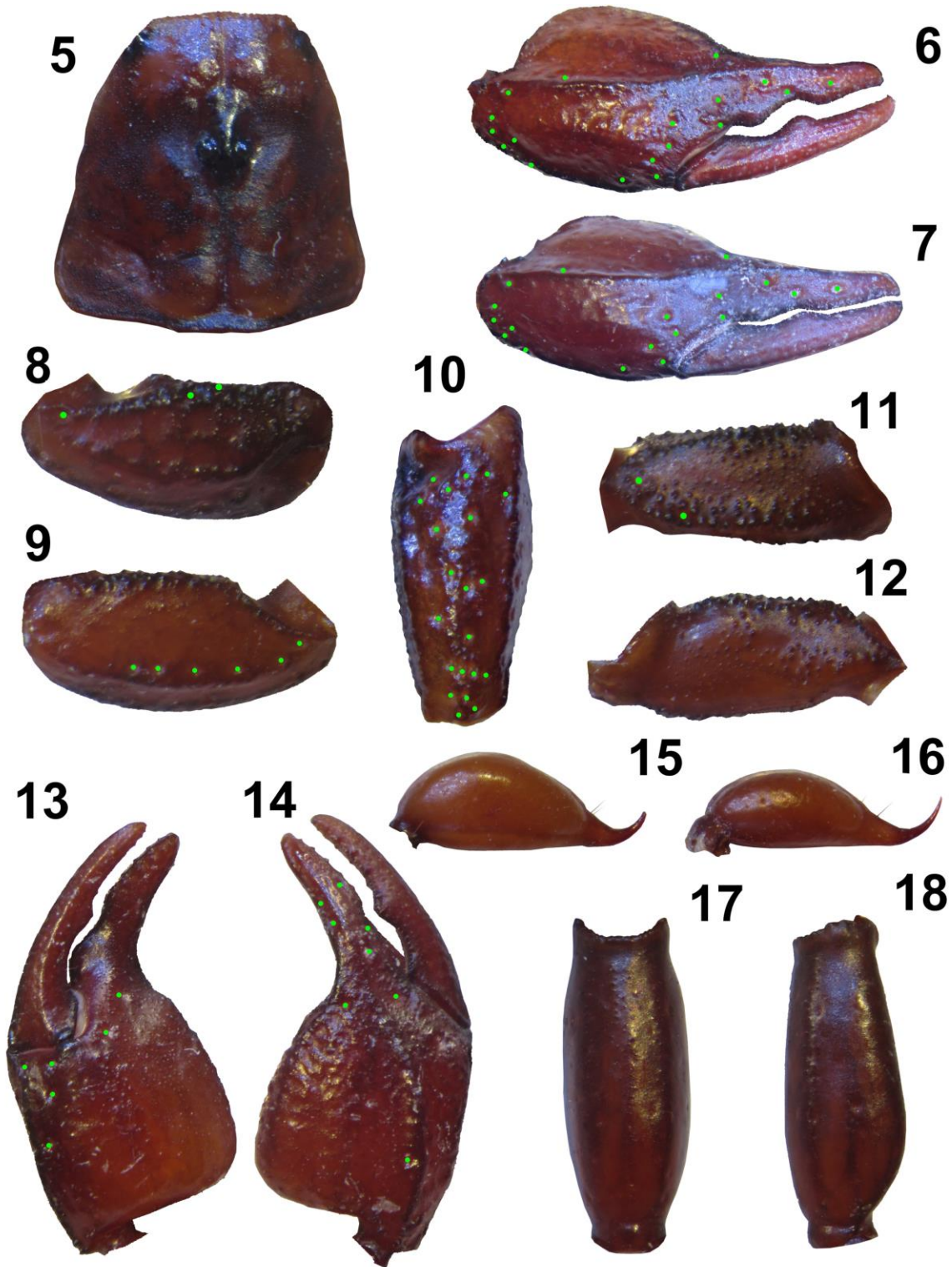
*Pectinal teeth in males* (n=21): 8/8 (2), 8/9 (1), 9/8 (3), 9/9 (14), 10/9 (1); in total, 8 in 19 % (8), 9 in 78.6 % (33); mean = 8.83, SD = 0.44.

*Pectinal teeth in females* (n=41): ?/? (2), 6/6 (4), 6/7 (4), 7/6 (6), 7/7 (23), 7/8 (1), 8/7 (1); in total, 6 in 23.07 % (18), 7 in 74.36 % (58) and 8 in 2.56 % (2); mean = 6.79, SD = 0.46.

*Pedipalp patella trichobothria Pv* (n=62): 5/6 (1), 6/2 (1), 6/5 (1), 6/6 (57), 7/6 (1), 7/7 (1); in total, 5 in (2), 6 in 99 % (118) %, and 7 in 1 % (3); mean = 6.01, SD = 0.20.

*Pedipalp patella trichobothria Pe* (n=62): *et* = 3/4 (1), 4/3 (1), 4/4 (50), 4/5 (4), 5/4 (2), 5/5 (3), 6/4 (1); in total, 3 in 2 % (2), 4 in 90 % (109), 5 in 7 % (12) and 6 in 1 % (1); mean = 4.09, SD = 0.33; *est* = 3/4 (1), 4/2 (1), 4/4 (60); *em* = 3/1 (1), 3/3 (60), 4/3 (1); in total, 3 in 98 % (122); mean = 2.99, SD = 0.20; in all specimens, *esb* = 2/2; *eb<sub>a</sub>* = 4/4; *eb* = 4/4.

***Hemispermatothore.*** Both right and left hemispermatothores of six specimens were studied. They have a well-developed lamina with distally squat, wide and not very tapered tip; well-developed basal constriction present; truncal flexure present; median projection with primary and secondary acuminate processes well-formed,



**Figures 5–18:** *Euscorpium phrygius* stat. n. 5. Carapace. 6. External view of the chela of adult male. 7. External view of the chela of adult female. 8. Dorsal view of pedipalp patella. 9. Ventral view of pedipalp patella. 10. External view of pedipalp patella. 11. Dorsal view of pedipalp femur. 12. Ventral view of pedipalp femur. 13. Ventral view of the chela. 14. Dorsal view of the chela. 15. Telson of adult male. 16. Telson of adult female. 17. Ventral view of the metasomal segment V. 18. Lateral view of the metasomal segment V.



and usually with from 2 to 4 spines; internal projection distally with 8–10 tines in its crown. The number and the shape of tines of the crown and of the secondary acuminate process varied between specimens and between the right and the left hemispermatophores.

### Description of the male lectotype

**Coloration:** Brown, reddish-brown basic color, with a dark brown-blackish variegation or marbling on the entire body; legs, telson, and chelicerae yellowish-light brown; sternites and pectines and genital operculum very light brownish-ivory; all pedipalps carinae darker, dark brown to blackish colored.

**Carapace:** A well visible granulation of different sizes is present, mainly on dark marbling, areas without marbling are smooth or slightly granulated; anterior edge granulate and more or less straight; deep posterior lateral furrows; two pairs of lateral eyes, and a pair of median eyes, situated distally of the middle; distance from center of median eyes to anterior margin is 42.37 % of carapace length.

**Mesosoma:** Tergites finely granulated; sternites glossy and punctated. Small spiracles inclined about 45° downward towards outside.

**Metasoma:** Dorsal carinae on segments I–IV granulated; ventrolateral and ventromedian carinae absent on segment I–IV; on segment V, small, scattered, and spaced granules are present mainly on distal 2/3 of the ventrolateral carinae, and distal 1/2 of the ventromedian carina; dorsal intercarinal spaces with fine granulation, smooth or almost smooth on the lateral and ventral surface.

**Telson:** Vesicle almost smooth, with ventral setae of different size, especially near the vesicle/aculeus juncture. A dark and furrowed strip is present in both the lateral parts in positions baseline and a lighter stripe is present in the ventral part over the entire length.

**Pectines:** Teeth number 9/9; middle lamellae number 7/6; several microsetae on proximal area of teeth, marginal lamellae, middle lamellae and fulcra.

**Genital operculum:** The genital operculum is formed by two longitudinally separated subtriangular sclerites; genital papillae protruding; a few microsetae are present.

**Sternum:** Pentagonal shape, type 2; as long as wide, with a deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal internal, dorsal external and ventral internal carinae tuberculated; external median carinae formed by serrated, little marked tubercles, present in the distal 1/2; anterior median formed by scattered tubercles; dorsal and ventral intercarinal spaces with granules of variable size, larger near the carinae. Patella: dorsal and ventral internal carinae granulated; dorsal and ventral external carinae rough to slightly granulated;

dorsal intercarinal surface with granules positioned so as to form a reticulation; ventral intercarinal surface almost smooth, only to few scattered minute granules near to ventral internal carinae is present. Dorsal patellar spur barely developed. Chelal carina *D1* is distinct, strong, dark and rough; *D4* is rounded and rough; *V1* carina is distinct, strong, dark and rough with a few tubercles proximally, following an oblique direction toward the inside of the trichobothrium *V1*; *V3* carina rounded, dark, smooth to rough; external carina granulated; dorsal intercarinal tegument with granules positioned so as to form a reticulation, the other intercarinal surfaces from smooth to rough with granules of variable size. Movable finger dentition: a *DD* on the distal tip is present. *MD* form a straight line consisting of very small denticles closely spaced of increasing number from distal to proximal position. *MD* in the most proximal part consist of a few granules positioned in two or three lines; *OD* consist of 8 denticles on movable finger and 6 denticles on fixed finger, immediately outside of *MD*; *ID* consist of 7 denticles on movable finger and 7 denticles on fixed finger, of which the most proximal is smaller, spaced from *MD*; *IAD* on movable finger consist of 7 denticles, three *IAD* in a row paired with the most proximal *ID*; *IAD* on fixed finger consist of 4 denticles.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 ( $V_{1-3} + Et_1$ ). Patella ventral (*Pv*): 6/6. Patella external (*Pe*):  $et = 4/4$ ,  $est = 4/4$ ,  $em = 3/3$ ,  $esb = 2/2$ ,  $eba = 4/4$ ,  $eb = 4/4$ . Femur: trichobothrium *d* is slightly proximal to *i*, while trichobothrium *e* is distal to both *d* and *i*, and situated on dorsal external carina.

**Legs:** With two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 11/12 spinules, of increasing size from proximal to distal, ending with both decentralized and paired spinule. Granulation well present on ventral surface of leg femora I–IV, and on dorsal surface of leg femora II–IV, it is mostly marked and dark ventrally.

**Chelicerae:** Movable finger: the dorsal distal denticle is much smaller than the ventral distal denticle; ventral edge is smooth with brushlike setae on the inner part; dorsal edge has five denticles: one large distal, two small subdistal, one large median, and a small basal. Fixed finger has four denticles: one distal, one subdistal, one median, and one basal, the last two in a fork arrangement; the internal surface has brushlike setae.

### Notes

1. Report of *E. phrygius* from “Moldavia” (Fet, 1989: 129) was based on two females collected by Constantine Jelski and labeled “Moldavia” (PAN; no date). This locality could refer to eastern Romania, Prut Valley between Botoșani and Iași where Jelski collected invertebrates in May 1863 (Tarkowski, 2011: 53). The specimens need further study. Dur-



**Figures 19–20:** *Euscorpium uludagensis* stat. n., male. **19.** Dorsal view. **20.** Ventral view.

ing the next two years, Jelski lived in Turkey and collected across the Ottoman Empire (Anatolia and the Balkans, west to Montenegro; e.g. he worked on a geological map of Tuzla in Bosnia). Other specimens of *Euscorpium* spp. collected by Jelski in the same collection (PAN) from Turkey (Istanbul) and Greece (Thessaloniki) are labelled 1864. The only *Euscorpium* currently confirmed for Romania is *E. carpathicus* (L., 1767) s.str.

2. Kulczyński (1903: 632, 678) reported “*E. germanus*” from Adampol (now Polonezköy), a suburb of Istanbul on the Asian side (with  $P_v = 6$ ). Fet & Sissom (2000) listed this record under *E. m. phrygius*. Geographically, *E. phrygius* is the closest known species; however, in absence of these specimens, we cannot confirm their identity. This locality was erroneously cited by Fet (1989: 129) as being situated in the European Turkey. We do not have any other information about *E. phrygius*, or related forms, in the European Turkey.

#### Ecological Notes

*E. phrygius* specimens were collected under stones in forests; this species prefers humid habitats in lowlands and mid-elevations up to 1200 m (Figs. 74–75). Due to the position of the Pontic Mountains, the Black Sea Region is characterized by humid climate. *E. phrygius* are found there mainly in red pine (*Pinus brutia*), black pine (*Pinus nigra*), and fir (*Abies* sp.)

forests but also present in hornbeam (*Carpinus* sp.) or mixed forests and near hazelnut orchards.

#### *Euscorpium uludagensis* Lacroix, 1995, stat. n.

(Figs. 19–36, Tables 1–3)

*Euscorpium mingrelicus uludagensis* Lacroix, 1995: 4.

*Holotype*: ♀, TURKEY: Bursa Province, Uludağ, June 1977, leg. Le Mao (MSNB) (examined).

The holotype, formerly in Lacroix collection, is now donated to MSNB. Lacroix did not designate a holotype; however, the subspecies was described based on a single female, and according to the Article 73.1.2 of the ICZN this specimen is the holotype.

#### REFERENCES

*Euscorpium mingrelicus*: Kritscher, 1993: 387 (in part, Uludağ).

*Euscorpium mingrelicus uludagensis*: Fet & Sissom, 2000: 372; Fet et al., 2004: 55; Fet & Soleglad, 2007: 419.

#### Material examined:

*Holotype*: ♀, TURKEY. Bursa Province: Uludağ, June 1977, leg. Le Mao (MSNB).

Other *E. uludagensis* stat. n. examined (not types) (26 specimens: 12 ♂, 14 ♀):



Figures 21–22: *Euscorpium uludagensis* stat. n., female. 21. Dorsal view. 22. Ventral view.

TURKEY. *Bursa Province*: Uludağ Mts., Alacan Village, leg. E.A. Yağmur, 1 ♂, 1 ♀ (GTC); Uludağ Mts., 1300-1500 m, *Pinus nigra*, 2 June 1959, leg. Schweiger, 1 ♀ (NHMW 21960); Uludağ Mts., 700-1500 m, chestnut-hazelnut, 1 ♀ (NHMW 21961); Uludağ Mts., environs of Baraklı Lake, 1271 m, 39°58'30.9"N, 29°17'14.9"E, 9 June 2013, leg. R.S. Kaya, 2 ♂ (AZMM); Keles District, Uludağ Mts., 1293m, 39°56'09,3"N, 29°16'54,7"E, 25 September 2010, leg. R.S. Kaya, 4 ♂, 4 ♀ (AZMM); same data, 2 ♂, 2 ♀ (GTC); Keles District, Uludağ Mts., 39°57'55,4"N, 29°15'24,7"E, 1060 m, 25 September 2010, leg. R.S. Kaya, 3 ♂, 5 ♀ (AZMM).

**Geographic range:** Turkey (northwest: Bursa Province) (Fig. 73).

**Diagnosis.** A small *Euscorpium* species, total length 21–26 mm (mean 22.9 mm). Color of adults brown to brown/reddish and dark brown, a darker reticulation or marbling on chelicerae, carapace, mesosoma, metasoma and legs is almost always present. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3}+Et_1$ ). The number of trichobothria on the pedipalp patella ventral surface is 5. The number of trichobothria on pedipalp patella external surface is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 3$ ,  $est = 4$ ,  $et = 4$ . The pectinal teeth number in males usually is 9, more rarely 8; in females

is 6 and 7. Mean  $Lchel/Wchel$  ratio is 2.15 in males and 2.47 in females. Dorsal patellar spur barely developed. Femur usually slightly shorter than patella; mean  $Lfem/Lpat$  ratio is 0.938. Carapace approximately as long as wide, tending to be shorter than wide; mean ratio  $Lcar/Wcar$  0.974. Mean ratio of  $Lmet/Lcar$  is 2.79 in males and 2.53 in females. Metasoma is robust in comparison with the other *Euscorpium* species; mean ratio  $Lmet/Wmet$  is 1.42 (1.33–1.50).

**Trichobothrial and pectinal teeth count variation.**

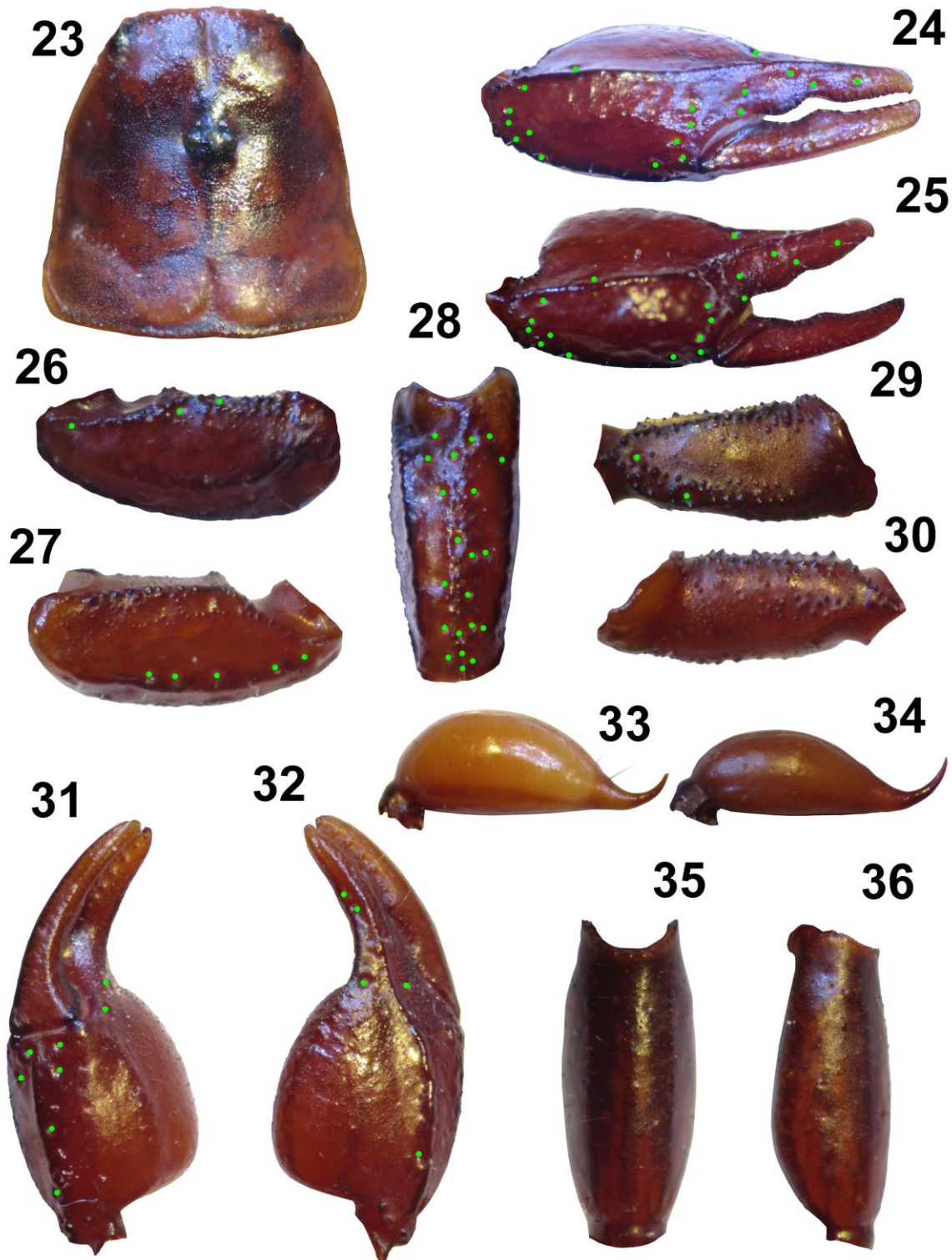
The variation observed in 27 examined specimens (12 ♂, 15 ♀) is given below.

*Pectinal teeth in males* (n=12): 8/8 (2), 9/8 (1), 9/9 (8), 9/10 (1); in total, 8 in 20.8 % (5), 9 in 75 (18); mean = 8.83, SD = 0.48.

*Pectinal teeth in females* (n=15): 6/6 (6), 6/7 (1), 7/6 (1), 7/7 (7); in total, 6 in 46.7 % (14) and 7 in 53.3 % (16); mean = 6.53, SD = 0.51.

*Pedipalp patella trichobothria Pv* (n=27): 5/4 (2), 5/5 (21), 5/6 (1), 6/5 (2), 6/6 (1); in total, 4 in 3.7 % (2), 5 in 87.04 % (47) and 6 in 9.26 % (5); mean = 5.05, SD = 0.36.

*Pedipalp patella trichobothria Pe* (n=27):  $et$  and  $eb_a = 4/3$  (1),  $4/4$  (26); in total, 3 in 1.85 % (1) and 4 in 98.15 % (53); mean = 3.98:  $est = 4/4$  (53),  $5/4$  (1); in all specimens,  $em = 4/4$ ;  $esb = 2/2$ ;  $eb = 4/4$ .



**Figures 23–36:** *Euscorpium uludagensis* stat. n., 23. Carapace. 24. External view of the chela of adult male. 25. External view of the chela of adult female. 26. Dorsal view of pedipalp patella. 27. Ventral view of pedipalp patella. 28. External view of pedipalp patella. 29. Dorsal view of pedipalp femur. 30. Ventral view of pedipalp femur. 31. Ventral view of the chela. 32. Dorsal view of the chela. 33. Telson of adult male. 34. Telson of adult female. 35. Ventral view of the metasomal segment V. 36. Lateral view of the metasomal segment V.

**Hemispermatothore.** Both right and left hemispermatothores of four males were studied. They have a well-developed lamina distally with squat and wide, ending in a rounded and large hook, and median projection with secondary acuminate process well-formed, and usually formed with 1 or 2 spines; internal projection distally with 6–8 tines in its crown. The number and the shape of tines of the crown and of the secondary acuminate process varied between specimens and between the right and the left hemispermatothores.

### Description of the male holotype

**Coloration:** Dark brown, brown-reddish basic color, with a dark brown-blackish variegation or marbling on the entire body; legs, telson, and chelicerae light brown; sternites and pectines and genital operculum light brownish.

**Carapace:** A very fine granulation is present, mainly on dark marbling, the areas without marbling are smooth or slightly granulated, and the area bounded by the lateral eyes and the median eyes is smooth; anterior edge more or less smooth and straight; deep posterior furrows; two pairs of lateral eyes, and a pair of median eyes, situated distally of the middle, distance from center of median eyes to anterior margin is 40.83 % of carapace length.

**Mesosoma:** Tergites very finely granulated; sternites glossy and punctated. Small spiracles inclined about 45° downward towards outside.

**Metasoma:** Dorsal carinae on segments I–IV with spaced, little pronounced granulated; ventrolateral carinae absent on segment I, absent or obsolete and on segments II–IV; ventromedian carina absent on segments I–IV; on segment V, small, spaced and serrated granules are present on ventrolateral and ventromedian carinae; dorsal intercarinal spaces with a fine granulation, almost smooth on the lateral and ventral surface.

**Telson:** Vesicle most smooth, with ventral setae of different size, especially near the vesicle/aculeus juncture. A furrowed strip is present in both the lateral parts in positions baseline, and two in the ventral part over the entire length.

**Pectines:** Teeth number 6/7; middle lamellae number 4/5; several microsetae on proximal area of teeth, marginal lamellae, middle lamellae and fulcra.

**Genital operculum:** The genital operculum is formed by two united subtriangular sclerites; a few microsetae are present.

**Sternum:** Pentagonal shape, type 2; more or less as long as wide, with a deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal carinae tuberculated; dorsal external carinae formed by slightly spaced and serrated tubercles; external median carinae formed by some, spaced, little pronounced tubercles;

ventral external carinae formed by messy, spaced tubercles; anterior median formed by spaced conical tubercles, varying in size; dorsal and ventral intercarinal spaces with granules of variable size. Patella: dorsal and ventral internal carinae tuberculated to granulated; dorsal external carinae rough; ventral external carinae rough; dorsal intercarinal surface with a few scattered granules; ventral intercarinal surface most smooth, only to few scattered minute granules near to ventral internal carinae is present. Dorsal patellar spur barely developed. Chelal carina *D1* is distinct, strong, dark and rough; *D4* is rounded and rough; *VI* is distinct, strong, dark and rough with a few tubercles proximally, following an oblique direction toward the inside of the trichobothrium *V1*; *V3* rounded; external carina rough; dorsal intercarinal tegument with granules positioned so as to form a reticulation, the other intercarinal surfaces from smooth to rough with granules of variable size. Movable finger dentition: In the most distal part is present a *DD* on the tip; *MD* consists of very small denticles closely spaced forming a more or less straight line, discontinued any 6–8 denticles at level of the *OD*, in proximal position the *MD* denticles overlap forming two lines; fixed finger has 6 *OD*, 6 *ID*, and 5 *IAD*; movable finger has 8 *OD*, 7 *ID*, and 7 *IAD*.

**Trichobothria:** Chela: trichobothria on the pedipalpus manus ventral surface 4/4 ( $V_{1-3} + Et_1$ ). Patella ventral (*Pv*): 5/5. Patella external (*Pe*):  $et = 4/4$ ,  $est = 4/4$ ,  $em = 3/3$ ,  $esb = 2/2$ ,  $eba = 4/4$ ,  $eb = 4/4$ . Femur: trichobothrium *d* is same level of *i*, while trichobothrium *e* is distal to both *d* and *i*, and situated on dorsal external carina, most on dorsal side.

**Legs:** With two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 10/8 spinules, of increasing size from proximal to distal, ending with two paired spinules. Granulation well-developed on ventral surface of leg femora I–III, and only on distal part of leg femora IV, weak on dorsal surface of leg femora I–IV.

**Chelicerae:** Movable finger: the dorsal distal denticle is much smaller than the ventral distal denticle; ventral edge is smooth with brushlike setae on the inner part; dorsal edge has five denticles: one large distal, two small subdistal, one large median, and a small basal. Fixed finger has four denticles: one distal, one subdistal, one median, and one basal, the last two in a fork arrangement; the internal surface has brushlike setae.

### Comments

Bonacina (1980) described *E. phrygius* stat. n. from western Turkey, as a form of smaller size than *E. m. mingrelicus*, with  $Pe = 21$  ( $et = 4$ ), and with a high  $et-est/est-dsb$  ratio. This is in agreement with our data.

Lacroix (1995) briefly described *E. m. uludagensis* and *E. m. legrandi*, also from western Turkey. He reported only the number of trichobothria and pectinal



**Figures 37–38:** *Euscorpium mingrelicus*, male. **37.** Dorsal view. **38.** Ventral view.

teeth. He separated *E. m. uludagensis* from two other western subspecies based on the value  $Pv = 5$  versus 6; and *E. m. legrandi* from *E. m. phrygius*, based on a configuration of an imaginary line connecting trichobothria  $V_1$ ,  $V_2$ , and  $V_3$ : “straight” in *E. m. legrandi*, and “broken” in *E. m. phrygius*. Here, we recognize and elevate to the species status *E. phrygius* stat. n., and *E. uludagensis* stat. n. However, we do not recognize *E. m. legrandi* due to a lack of diagnostic characters (see below). Pending more data, especially genetic marker comparisons, we move *E. m. legrandi* to synonymy with *E. phrygius* stat. n.

*E. phrygius* stat. n. and *E. uludagensis* stat. n. can be differentiated from *E. mingrelicus* as follows; (1) *E. mingrelicus* has  $et = 5$ , rarely 6 while *E. phrygius* and *E. uludagensis* have  $et = 4$ ; (2) *E. mingrelicus* has a  $Lmet/Wmet$  ratio above than 1.50 (mean 1.61), versus a  $Lmet/Wmet$  ratio less than 1.51 (mean 1.39); (3) *E. mingrelicus* is larger, with total sizes between 27 and 42 mm (mean 31.7 mm), while these sizes of *E. phrygius* and *E. uludagensis* are between 22 and 27 mm (mean 23.5 mm).

*E. phrygius* stat. n. and *E. uludagensis* stat. n. can be differentiated from *E. ciliciensis* stat. n. as follows; (1) *E. phrygius* and *E. uludagensis* have  $et = 4$ , versus  $et = 5$  in *E. ciliciensis*; (2) *E. phrygius* and *E. uludagensis* have a  $Pv = 5–6$ , versus  $Pv = 7$  in *E. ciliciensis*; (3) *E. phrygius* and *E. uludagensis* have a  $Lmet/Wmet$  ratio

lower of 1.51 (mean 1.39), versus a  $Lmet/Wmet$  ratio higher of 1.50 (mean 1.72); (4) *E. phrygius* and *E. uludagensis* have  $L/W$  ratio of the metasomal segment V less than 2.71, while in *E. ciliciensis* it is above 2.70; (5) *E. phrygius* and *E. uludagensis* have a dark brown/reddish color, with darker marbling well-visible, and present also on chelicerae, while *E. ciliciensis* has a light brown/reddish color, with or without slight marbling, and without marbling on chelicerae; (6) *E. phrygius* and *E. uludagensis* have the telson wider than high in both males and females, with profile more tapering distally, while *E. ciliciensis* has the telson higher than wide in males ( $Htel/Wtel$  mean 1.10,  $SD=0.09$  in males and mean 0.98,  $SD=0.04$  in females), with profile not tapering distally; (7) the size of *E. phrygius* and *E. uludagensis* is between 22 and 27 mm (mean 23.5 mm), while *E. ciliciensis* is between 27 and 42 mm (mean 31.7 mm).

*E. phrygius* and *E. uludagensis* are morphologically well separated from *E. mingrelicus* and *E. ciliciensis* stat. n. but appear to be similar to each other (small size, similar  $Lmet/Wmet$  and  $Ltel/Wtel$  ratios, etc.; see Tables 1 and 2). However, they can easily be distinguished from each other mainly by the number of the patellar ventral trichobothria:  $Pv = 6$  in *E. phrygius*, and  $Pv = 5$  in *E. uludagensis*. These two species are found south from the western part of the Pontic Mountains, or within this range, and near the Sea of Marmara. However, they are

clearly allopatric: *E. uludagensis* is known only from Uludağ Mts., while *E. phrygius* has never been found in this area.

### Ecological Notes

*E. uludagensis* prefers humid and cool habitats between 700–1500 m (Figs. 76–77). Specimens were collected under the stones, mainly in pine forests (*Pinus nigra*) but were also found in mixed forests dominated by oak (*Quercus* sp.), hornbeam (*Carpinus* sp.), and hazelnut (*Corylus* sp.).

### *Euscorpius mingrelicus* (Kessler, 1874)

(Figs. 37–54, Tables 1–3)

*Scorpio mingrelicus* Kessler, 1874: 25–26.

Syntypes were formerly held in ZISP, now lost. Kessler did not designate a holotype. Scherabon et al. (2000) fixed a neotype from Batumi, Georgia (Caucasus).

*Neotype*: ♀, GEORGIA. *Adzharia*: Batumi, Botanical Garden, 28 August 1985, leg. V. Fet (NHMW 14644).

### SYNONYMS:

*Euscorpius picipes* Simon, 1878: 158–159 (synonymized by Birula, 1896: 230).

*Syntypes*: ♂, ♀ (MNHN), “Transcaucasia”, now Georgia.

*Euscorpius mingrelicus ollivieri* Lacroix, 1995: 4, **syn. n.**

Type specimens were formerly in Lacroix collection, present location unknown, probably lost (G. Dupré, pers. comm.). We designate here a neotype according to the Article 75 of the ICZN.

*Neotype*: ♂, TURKEY. *Artvin Province*: Cankurtaran Pass, 260 m, 11 May 1987, leg. A. Vigna Taglianti (MZUR 133).

### REFERENCES (selected):

*Euscorpius mingrelicus*: Birula, 1896: 230; Birula, 1898: 138–140, fig. 2; Birula, 1900: 16, 19; Kulczyński, 1903: 678; Birula, 1917b: 168, 192–208, plate 3, fig. 7–8, plate 5, figs. 1–2; Bonacina, 1980: 55–58, 71–77, figs. 1–4 (in part); Fet, 1989: 126–127 (in part); Lacroix, 1991: 20–21, fig. 95, 96b, 97, 98b–d, 100, 101, 108–113, 120–125 (in part); Fet, 1993: 1–8 (in part); Crucitti, 1999: 87 (in part); Fet & Sissom, 2000: 368–372 (in part; includes all references before 1998); Gantenbein et al., 2000: 855; Crucitti & Cicuzza, 2001: 227 (in part); Soleglad & Sissom, 2001: 90, figs. 63, 119, 180; Fet et al., 2003: 1518–1520; Fet et al., 2004: 48, 50; Fet & Soleglad, 2007: 417; Kaltsas et al., 2008: 224 (in

part); Vignoli & Salomone, 2008: 211, fig. 26 (in part); Fet, 2010: 6.

*Euscorpius mingrelicus mingrelicus*: Fet & Sissom, 2000: 368; Fet et al., 2004: 55; Vignoli & Salomone, 2008: 214.

*Euscorpius mingrelicus ollivieri*: Fet & Sissom, 2000: 371; Fet et al., 2004: 55; Fet & Soleglad, 2007: 419.

**Geographic range:** Georgia (west), Russia (southwest; Krasnodar Province near its border with northwestern Georgia), Turkey (north) (Fig. 73).

### Material examined:

*Neotype*: ♀, GEORGIA. *Adzharia*: Batumi, Botanical Garden, 28 August 1985, leg. V. Fet (NHMW 14644).

Other *E. mingrelicus* examined (not types) (133 specimens: 48 ♂, 85 ♀):

GEORGIA. *Abkhazia*: Gumista Reserve, 43.1736° N, 41.0483° E, 8–16 July 2008, leg. N. Kovblyuk, 2 ♂, 4 ♀ (VFPC); Pitsunda District, Pitsunda-Miuser Reserve, 43°09'43" N, 40°25'07" E, 1–7 July 2006, leg. N. Kovblyuk, 3 ♂, 4 ♀ (GTC); Kobuleti District, Tskhemvani, near Kintrishi Reserve, 41°47'25.1"N, 41°57'36.8"E, leg. P. Crucitti, 7 ♂, 16 ♀ (GTC). *Adzharia*: Same label as neotype, 4 ♂, 1 ♀ (NHMW 14644), 4 ♂, 2 ♀ (NHMW 14645), 3 ♂, 3 ♀ (NHMW 14646), 1 ♂ (MSNB 13706). TURKEY. *Artvin Province*: Artvin, Hatila Valley, 25 July 2011, leg. E.A. Yağmur, 1 ♂, 1 ♀ (GTC 468, 469); Artvin, Ormanli Village, 6 August 1999, leg. P. Crucitti, 1 ♂, 8 ♀ (SRSN); Cankurtaran Pass, 260 m, 11 May 1987, leg. A. Vigna Taglianti, 1 ♂ (MZUR 133); same data, 700 m, 2 ♂, 2 ♀ (MZUR 130–132); same data, leg. M. Zapparoli, 1 ♂ (MZUR 134); surroundings of Artvin, Arhavi, 150 m, 11 May 1987, leg. A. Vigna Taglianti, 1 ♀ (MZUR 135). *Karabük Province*: Safranbolu, Eflani road fork, 41°20'23"N, 32°12'19"E, 29 June 2009, leg. Y. Kumlutaş, 1 ♂ (AZMM). *Kastamonu Province*: Azdavay, entrance to Vala Valley, 27 April 2013, leg. K.B. Kunt & T. Danişman, 2 ♂, 1 ♀ (AZMM); Azdavay, Çatak Canyon road, 41°39'0.50"N, 33°14'56.60"E, 28 April 2013, leg. K.B. Kunt & T. Danişman, 1 ♂, 3 ♀ (AZMM); Bağyurdu, 41°59'15"N, 33°01'56"E, 18 May 2011, leg. K.B. Kunt & A. Kızıltuğ, 9 ♀ (AZMM); Ecevit Pass, 41°46'39.00"N, 33°43'5.00"E, 25 May 2012, leg. K.B. Kunt & T. Danişman, 3 ♂, 3 ♀ (AZMM); 25 km to Ilgaz Mt., Ilgaz Mountain National Park, 31 May 2014, leg. K.B. Kunt & T. Danişman, 1 ♂ imm., 1 ♀ imm. (AZMM); Pınarbaşı road, 27 April 2013, leg. K.B. Kunt & T. Danişman, 3 ♂, 1 ♂ imm., 2 ♀, 1 ♀ imm. (AZMM). *Rize Province*: south of İkizdere, 40.71N, 40.615E, GD-170/171, 3 ♂, 5 ♀ (VFPC 474); south of Ardeşen, Çamlıhemşin–Çat, 1140 m, 1 August 1968, leg. H.M. Steiner, 1 ♀ imm. (NHMW 21965); same data but 1 August 1967, 4 ♀, 3 ♀ (NHMW 21966); south of



Figures 39–40: *Euscorpium mingrelicus*, female neotype. 39. Dorsal view. 40. Ventral view.

Ardeşen, Ülkü, 23 June 1971, leg. H.M. Steiner, 1 ♀, 1 ♀ imm. (NHMW 21967); south of Çat, Hemşin, 1800–2000 m, 9 August 1967, 5 ♀ (NHMW 21968); *Samsun Province*: 18 August 1972, leg. A. Valle (MSNB 9155). *Sinop Province*: Dranaz Mt., 1225 m, 7 June 2013, leg. K.B. Kunt & T. Danişman, 5 ♀ (AZMM).

**Diagnosis.** A medium *Euscorpium* species, total length 27–42 mm (mean 31.66 mm). Color of adults dark brown to brown/reddish, a darker variegation or marbling on chelicerae, carapace, mesosoma, metasoma, and legs is present. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3}+Et_1$ ). The number of trichobothria on the pedipalp patella ventral surface usually is 6. The number of trichobothria on pedipalp patella external surface usually is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 3$ ,  $est = 4$ ,  $et = 5$ . The pectinal teeth number in males usually is 8–9 and in females usually 6–7, more rarely 5.  $Lchel/Wchel$  ratio on average is 2.36 in males and 2.49 in females. Dorsal patellar spur little developed. Femur usually slight shorter than patella; mean  $Lfem/Lpat$  ratio is 0.956. Carapace more or less as long as wide, but it tends to be shorter than wide; mean ratio  $Lcar/Wcar$  0.96. Mean ratio of  $Lmet/Lcar$  is 2.85 in

males and 2.60 in females. Mean ratio  $Lmet/Wmet$  is 1.61 (1.51–1.72).

**Trichobothrial and pectinal teeth count variation.**

The variation observed in 133 examined specimens (48 ♂, 85 ♀) is given below.

*Pectinal teeth in males* (n=48): 8/7 (1), 8/8 (19), 8/9 (5), 9/8 (6), 9/9 (15), 9/10 (1), 10/10 (1); in total, 8 in 52.08% (50), 9 in 43.75% (42); 7 in 1.04% (1), and 10 in 3.12% (3); mean = 8.49, SD = 0.58.

*Pectinal teeth in females* (n=85): 5/5 (2), 5/6 (3), 6/5 (1), 6/6 (25), 6/7 (6), 7/6 (6), ?/7 (1), 7/7 (40), 8/7 (1); in total 7 in 55.62% (94), 6 in 39.05% (66), 5 in 4.73% (8), and 8 in 0.59% (1); mean = 6.52, SD = 0.60.

*Pedipalp patella trichobothria Pv* (n=131): 5/5 (2), ?/6 (2), 6/? (1), 5/6 (8), 6/5 (3), 5/7 (2) 6/6 (103), 6/7 (4), 7/6 (2), 7/7 (3), 7/8 (1); in total, 6 in 87.26% (226), 5 in 6.56% (17), 7 in 5.79% (15) and 8 in 0.38% (1); mean = 6.00, SD = 0.38.

*Pedipalp patella trichobothria Pe* (n=131):  $et = 4/4$  (6), 4/5 (9), ?/5 (2), 5/3 (1), 5/4 (7), 5/5 (95), 2/6 (1), 5/6 (1), 6/? (1), 6/5 (4), 6/6 (5); in total, 5 in 82.62% (214), 4 in 10.81% (28), 6 in 6.56% (17); mean = 4.96, SD = 0.41;  $est = ?/4$  (2), 3/4 (2), 4/3 (7), 4/4 (120);  $em = ?/3$



(2), 3/2 (4), 3/3 (125); *esb* = 2/2 (2), 1/2 (1), 2/2 (128); *eb<sub>a</sub>* = 2/4 (2), 3/4 (2), 4/4 (126), 4/5 (1); *eb* = 2/4 (2), 3/4 (1), 4/4 (128).

**Hemispermatothore.** Both right and left hemispermatothores of eleven males were studied. They have a well-developed lamina tapered distally, ending in a pointed hook, with median projection with secondary acuminate processes formed as a more or less undulated and elongated band, which begins from the basal median plica and ending on primary acuminate process lobes; internal projection distally with 6–13 tines in its crown. The number and the shape of tines of the crown and of the secondary acuminate process varied between specimens and between the right and the left hemispermatothores.

### Description of the female neotype

**Coloration:** Dark brown basic color, with a slightly less dark tergites; brown-blackish variegation or marbling on mesosoma, legs, and chelicerae, less visible on metasoma and carapace; the color of the legs fades from yellow on the tarsi to brown; sternites fade from dark brown to light brown, from distal to proximal segments; pectines and genital operculum light brownish.

**Carapace:** A fine granulation is present, except on the area bounded by the lateral eyes and the median eyes, which is smooth; anterior edge with a few small granules and straight; deep posterior furrows; two pairs of lateral eyes, and a pair of median eyes, situated distally of the middle, distance from center of median eyes to anterior margin is 42.66 % of carapace length.

**Mesosoma:** Tergites very finely granulated; sternites glossy and punctated. Small spiracles inclined about 45° downward towards outside.

**Metasoma:** Dorsal carinae on segments I–IV with spaced, little pronounced granules; ventrolateral carinae absent on segment I, absent or obsolete and on segments II–IV; ventromedian carina absent on segments I–IV; on segment V, very small and spaced granules are present on ventrolateral and ventromedian carinae; on segments I–IV, dorsal intercarinal spaces granulated, with a few small granules on the lateral surface and smooth or almost smooth on ventral, segment V with a few scattered granules on all surfaces.

**Telson:** Vesicle smooth, with ventral setae of different size, especially near the vesicle/aculeus juncture. A furrowed strip is present in both the lateral parts in positions baseline, and two in the ventral part over the entire length.

**Pectines:** Teeth number 7/6; middle lamellae number 4/4; several microsetae on proximal area of teeth, marginal lamellae, middle lamellae and fulcra.

**Genital operculum:** The genital operculum is formed by two united subtriangular sclerites; a few microsetae are present.

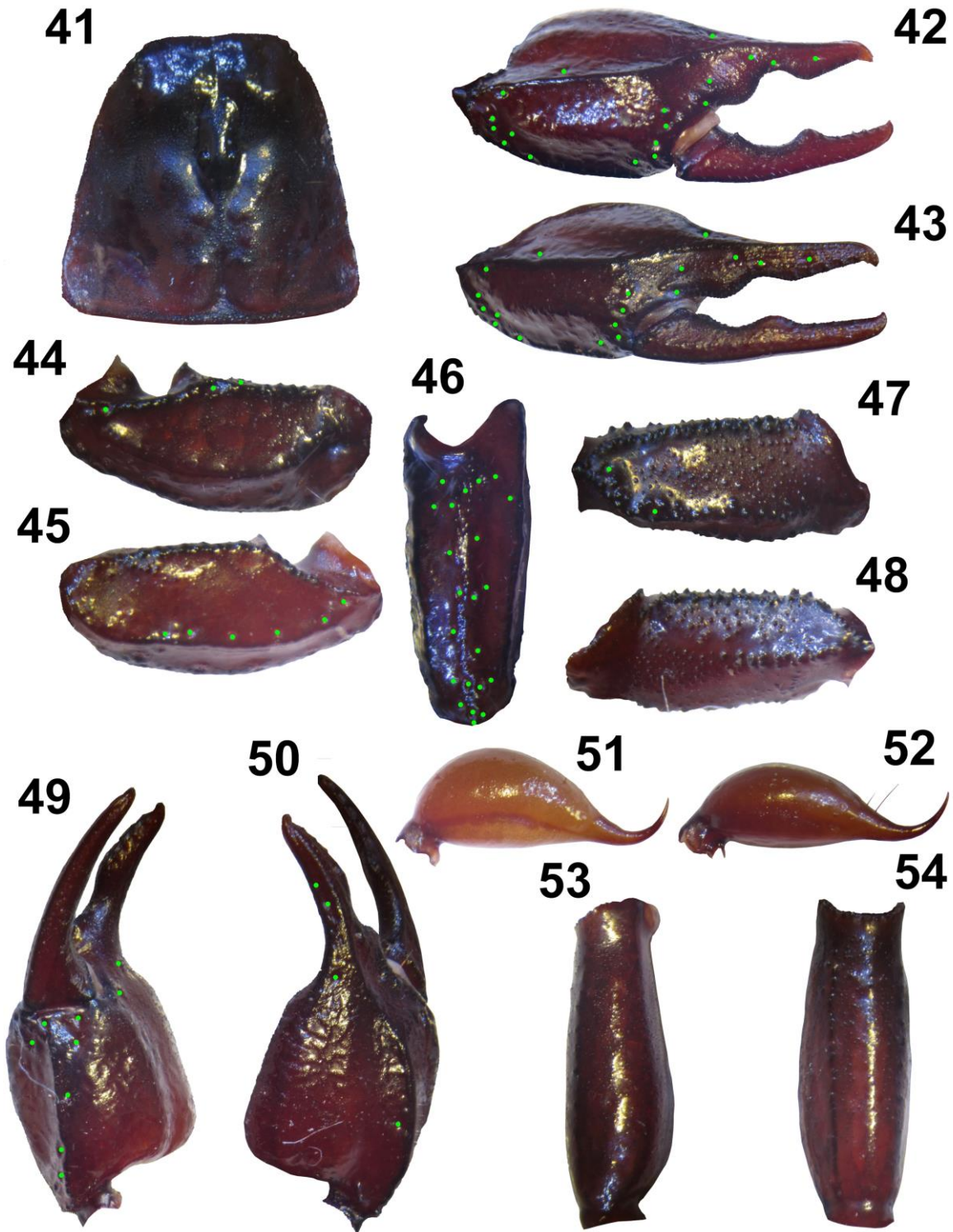
**Sternum:** Pentagonal shape, type 2; wider than long, with a deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal and dorsal external carinae tuberculated; external median carinae formed by few serrated, little pronounced tubercles; ventral external carinae well formed by spaced tubercles just in proximal half; anterior median formed by a few spaced conical tubercles, varying in size; dorsal and ventral intercarinal spaces with granules of variable size. Patella: dorsal internal carinae tuberculated to granulated; ventral internal carinae formed by serrated tubercles; dorsal and ventral external carinae from rough to slightly crenulated; dorsal intercarinal tegument with granules positioned so as to form a reticulation; ventral intercarinal surface half smooth, a few scattered granules near to ventral internal carinae are present. Dorsal patellar spur little developed. Chelal carina *D1* is distinct, strong, dark and rough; *D4* is rounded and rough; *V1* is distinct, strong, dark and rough with a few tubercles proximally, following an oblique direction toward the inside of the trichobothrium *V1*; *V3* rounded; external carina rough; dorsal and external intercarinal tegument with minute granules positioned so as to form a reticulation, the internal intercarinal tegument granulated, and ventral intercarinae surface from smooth to granulated. Movable finger dentition: in the most distal part a *DD* is present; *MD* consist of very small denticles, closely spaced, forming a more or less straight line, discontinued any 6–8 denticles at the level of the *OD*, in proximal position the *MD* denticles overlap forming two lines; fixed finger has 6 *OD*, 6 *ID*, and 4 *IAD*; movable finger has 7 *OD*, 7 *ID*, and 7 *IAD*.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 (*V1-3+Et1*). Patella ventral (*Pv*): 6/6. Patella external (*Pe*): *et* = 5/5, *est* = 4/4, *em* = 3/3, *esb* = 2/2, *eb<sub>a</sub>* = 4/4, *eb* = 4/4. Femur: trichobothrium *d* is slightly proximal to *i*, while trichobothrium *e* is distal to both *d* and *i*, and situated on dorsal external carina.

**Legs:** With two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 9/10 spinules, of increasing size from proximal to distal; 3–4 main flanking tarsal setae present. Basitarsus with a few prolateral stout spinules on legs I and II, without spinules on legs II–IV; granulation well present on ventral and dorsal surface of all leg femora, it is mostly marked and dark ventrally.

**Chelicerae:** Movable finger: the dorsal distal denticle is much smaller than the ventral distal denticle; ventral edge is smooth with brushlike setae on the inner part; dorsal edge has five denticles: one large distal, two small subdistal, one large median, and a small basal.



**Figures 41–54:** *Euscorpium mingrelicus*. 41. Carapace. 42. External view of the chela of adult male. 43. External view of the chela of adult female. 44. Dorsal view of pedipalp patella. 45. Ventral view of pedipalp patella. 46. External view of pedipalp femur. 47. Dorsal view of pedipalp femur. 48. Ventral view of pedipalp femur. 49. Ventral view of the chela. 50. Dorsal view of the chela. 51. Telson of adult male. 52. Telson of adult female. 53. Lateral view of the metasomal segment V. 54. Ventral view of the metasomal segment V.

		<i>E. ciliciensis</i> stat. n.		<i>E. mingrelicus</i>		<i>E. phrygius</i> stat. n.		<i>E. uludagensis</i> stat. n.	
		Topotype ♂	Topotype ♀	Topotype ♂	Neotype ♀	Lectotype ♂	Paralectotype ♀	Topotype ♂	Topotype ♀
Total	Length	27.69	27.06	31.17	28.91	24.89	25.47	22.29	24.28
Carapace	Length	4.02	4.02	4.61	4.14	3.36	3.66	3.06	3.60
	Post. width	3.87	4.07	4.74	4.50	3.51	3.78	3.18	3.78
Metasoma	Length	10.89	10.14	13.07	10.61	10.07	9.15	8.61	8.85
Segment I	Length	1.41	1.26	1.74	1.42	1.32	1.20	1.08	1.17
	Width	1.45	1.44	1.75	1.61	1.63	1.50	1.41	1.49
Segment II	Length	1.74	1.56	2.10	1.68	1.56	1.41	1.32	1.32
	Width	1.31	1.26	1.35	1.44	1.44	1.32	1.26	1.32
Segment III	Length	1.92	1.74	2.28	1.86	1.68	1.56	1.47	1.50
	Width	1.26	1.20	1.56	1.38	1.43	1.27	1.25	1.20
Segment IV	Length	2.22	2.04	2.63	2.17	2.03	1.86	1.80	1.86
	Width	1.20	1.12	1.50	1.30	1.32	1.20	1.14	1.14
Segment V	Length	3.60	3.54	4.32	3.48	3.48	3.12	2.94	3.00
	Width	1.20	1.13	1.49	1.30	1.33	1.26	1.26	1.14
Telson	Length	4.14	3.42	4.50	3.54	3.66	3.12	3.30	3.01
Vesicle	Length	3.06	2.40	3.36	1.38	2.94	2.19	2.46	2.10
	Width	1.53	1.26	1.91	1.14	1.68	1.26	1.56	1.14
	Height	1.74	1.20	1.80	1.26	1.49	1.02	1.44	1.02
Aculeus	Length	1.08	1.02	1.14	1.38	0.93	0.93	0.84	0.91
Femur	Length	3.33	3.24	3.66	3.36	2.67	2.70	2.34	2.64
	Width	1.20	1.20	1.50	1.41	1.08	1.11	0.96	1.08
Patella	Length	3.36	3.30	3.96	3.54	2.82	2.94	2.55	2.82
	Width	1.27	1.26	1.68	1.56	1.20	1.26	1.14	1.26
Chela	Length	6.81	6.69	8.10	7.20	6.01	5.99	5.14	5.82
	Width-A	2.82	2.64	3.42	2.94	2.64	2.45	2.40	2.46
Movable Finger	Length	3.71	3.66	4.74	4.16	3.66	2.70	3.02	2.64
Ratios	CarA (%)	42.54	44.03	42.71	42.75	42.37	42.62	42.16	41.66
	Lcar/Wcar	1.039	0.988	0.972	0.920	1.008	0.968	0.962	0.952
	Lcar/Lfer	1.207	1.241	1.259	1.232	1.326	1.355	1.281	1.363
	Lcar/Ltel	0.971	1.175	1.024	1.169	0.967	1.173	0.927	1.195
	Lchel/Wchel	2.415	2.534	2.368	2.449	2.275	2.440	2.140	2.360
	L/W met.seg I	0.971	0.875	0.986	0.878	0.812	0.800	0.766	0.786
	L/W met.seg II	1.330	1.238	1.296	1.162	1.083	1.068	1.047	1.000
	L/W met.seg III	1.524	1.450	1.461	1.348	1.171	1.226	1.178	1.250
	L/W met.seg IV	1.850	1.828	1.752	1.663	1.541	1.550	1.579	1.631
	L/W met.seg V	3.000	3.138	2.903	2.636	2.624	2.476	2.333	2.631
	Lmet/Wmet	1.696	1.650	1.647	1.510	1.410	1.396	1.363	1.407
	Lmet/Lcar	2.709	2.522	2.835	2.562	2.846	2.500	2.814	2.458
	Lfem/Lpat	0.991	0.982	0.924	0.949	0.947	0.918	0.942	0.936

**Table 1:** Measurements (mm) and morphometric ratios of *Euscorpius* species discussed in this paper.

Fixed finger has four denticles: one distal, one subdistal, one median, and one basal, the last two in a fork arrangement; the internal surface has brushlike setae.

### Comments

*E. mingrelicus* s.str. is found along the Black Sea coast of Turkey and Georgia, slightly expanding beyond the northwestern border of Georgia (Abkhazia) into Russia (Krasnodar Province). The range of this species is limited to the south by the northern Pontic Mountains, which separate it from the range of *E. phrygius* stat. n.

*E. mingrelicus* can be differentiated from *E. ciliciensis* as follows; (1) *E. mingrelicus* usually has  $Pv = 6$ , versus  $Pv = 7$  in *E. ciliciensis*; (2) *E. mingrelicus* is dark brown/reddish with marbling not always well-visible, especially on carapace and metasoma, well-visible on chelicerae, while *E. ciliciensis* is light brown/reddish with or without slight marbling, and without marbling on chelicerae; (3) in *E. mingrelicus*, the telson is wider than high in both males and females ( $H_{tel}/W_{tel}$  mean 0.91,  $SD=0.10$  in males, and 0.86,  $SD=0.06$  in females), more tapering distally in profile, while in *E. ciliciensis* the telson is higher than wide in males ( $H_{tel}/W_{tel}$  mean 1.10,  $SD=0.09$  in males and mean 0.98,  $SD=0.04$  in females), and does not taper distally in profile.

*E. mingrelicus* can be differentiated from *E. phrygius* and *E. uludagensis* as explained above.

No subspecies are currently distinguished in *E. mingrelicus*. Lacroix (1995) distinguished two subspecies, *E. m. ollivieri* in Turkey, and *E. m. mingrelicus* in Georgia. We did not find this division justified (as explained below), and we moved *E. m. ollivieri* Lacroix, 1995 into synonymy with *E. mingrelicus* s.str. However, considering the high endemism in the genus *Euscorpium*, an additional investigation, such as a detailed phylogeographic analysis, would be useful to understand history and composition of this species.

We do not include in *E. mingrelicus* any Balkan taxa. Two formally valid names listed in literature are *E. mingrelicus dinaricus* Di Caporiacco, 1950 and *E. m. caporiaccoi* Bonacina, 1980 (both with type locality in Bosnia); their status remains to be determined.

### Notes

1. Reports of “*E. germanus*” or “*E. mingrelicus* complex” from Greece (Kinzelbach, 1975; Kritscher, 1993; Fet & Sissom, 2000; Vignoli & Salomone, 2008) are not confirmed. These reports are based on three misidentified records: (a) *E. kritscheri* Fet et al., 2013 (Tinos Island), misidentified by F. Werner (1902) as *E. germanus*; (b) most likely misidentified specimens from Ikaria Island (Werner, 1935; Kinzelbach, 1975; specimens not found in NHMW, see Kritscher, 1993: 387); and (c) one specimen reported from Ioannina (Guerra, 1979: 243) (MSNB 10019). Our examination of

the latter (V.F., 2014) shows that this miniature *Euscorpium*, collected by A. Vigna on 18 October 1974, has  $em=4$ . It does not belong to subgenus *Alpiscorpium* but rather is related to small-sized Greek species of subgenus *Euscorpium* s.str. such as *E. erymanthius* Tropea et al., 2013. At the same time, we do not exclude that the Albanian *E. beroni* or a related form can be found in northwestern Greece.

2. We have no data to confirm the reports of “*E. germanus*” or “*E. mingrelicus* complex” from Syria (Kinzelbach, 1985; Kaltsas et al., 2008).

### Ecological Notes

*E. mingrelicus* prefers humid habitats in lowlands and middle altitudes, and is found from sea level to 2000 m (Figs. 78–79). The eastern portion of the Pontic Mountains range is higher than its western part; therefore the eastern part of the Black Sea Region is more rainy and humid than the western. Specimens were collected under the stones and in rock cracks or roadside wall cracks. They are mainly found in black pine forests but are also found in hornbeam (*Carpinus* sp.) or mixed forests and next to tea orchards.

Birula (1917a, 1917b) provided a detailed account of habitat distribution of *E. mingrelicus* in the Russian Caucasus (the area which corresponds mainly to modern Georgia as well as southern coastal part of Krasnodar Province of Russia, and part of Artvin Province of Turkey). Ecology of this species in the Caucasus has not been sufficiently studied. Fet (1993) collected over 200 specimens in one night in stone walls in a very humid, subtropical locality next to Black Sea coast in southeastern Georgia (Adzharia, Batumi Botanical Garden) in August 1985. Density in drier oak forest litter in Imeretia (Adzhmeti) was much lower (Fet, 1993).

### Subgenus Incertus

#### *Euscorpium ciliciensis* Birula, 1898, stat. n.

(Figs. 55–72, Tables 1–3)

*Euscorpium ciliciensis* Birula, 1898: 136–140, fig. 1.

*Syntypes*: 2 ♀, Turkey, Bulghar Dagh (=Bolkar Mountains), 1897, leg. M. Holtz (ZISP 956).

### REFERENCES:

- Euscorpium ciliciensis*: Birula, 1900: 16; Werner, 1902: 605; Kulczyński, 1903: 679; Birula, 1917b: 168; Di Caporiacco, 1950: 223; Bonacina, 1980: 49; Fet, 1985: 3–5 (“status uncertain”); Fet et al., 2003: 249.
- Euscorpium germanus ciliciensis*: Di Caporiacco, 1950: 209.
- Euscorpium mingrelicus ciliciensis*: Fet, 1989: 127; Lacroix, 1991: 21 (mentioned as a species, under a heading “subspecies”); Fet & Sissom, 2000: 370 (includes all



Figures 55–56: *Euscorpium ciliciensis* stat. n., male. 55, Dorsal view. 56, Ventral view.

references before 1998); Fet et al., 2004: 55; Fet & Soleglad, 2007: 419; Vignoli & Salomone, 2008: 214.

**Material examined:**

Type material: *Syntypes*: 2 ♀, Turkey, Bulghar Dagh (=Bolkar Mountains), 1897, leg. M. Holtz (ZISP 956) (examined by V.F. in 1985).

Other *E. ciliciensis* stat. n. examined (not type series) (28 specimens: 15 ♂, 13 ♀):

TURKEY. *Konya Province*: near Ivriz, 1100–1300 m, 16 May 1988, leg. P. Audisio, 1 ♀ (MZUR). *Mersin Province*: Tarsus District, Çamlıyayla, 37°09'14"N, 34°40'07"E, 1105 m, 12 May 2008, leg. A. Akkaya & R.S. Kaya, 2 ♀ (AZMM); Erdemli, 4 km N of Koramışlı Village, 1236 m, 36°45'42.1"N, 34°09'54.2"E, 5 July 2013, leg. E.A. Yağmur, 1 ♂ (AZMM); Bürücek Plateau, 1300 m, 16 May 1988, leg. M. Zapparoli, 1 ♂ (MZUR). *Niğde Province*: 6 km N of Darboğaz, 37°25'N, 34°33'53"E, 2360 m, leg. E.A. Yağmur & H. Koç, 1 ♂ imm., 1 ♀ imm. (AZMM); 6 km N of Darboğaz, 2350 m, 37°24'51.7"N, 34°33'54.9"E, 20 August 2012, leg. E.A. Yağmur & H. Koç, 1 ♂, 2 ♀ (AZMM); Bolkar Mts., Ulukışla, 37°24'47.2"N, 34°33'57.4"E, 4 July 2013, leg. E.A. Yağmur & H. Koç, 7 ♂, 3 ♀ (AZMM); same data, 4 ♂, 3 ♀ (GTC); Bulga (=Bolkar)-Maden Village, north of Eregli, 14 June 1965, leg. F. Ressler, 1 ♀ imm. (NHMW 21962).

**Geographic range:** Turkey: Konya and Mersin Provinces (eastern part of the Central Taurus Mts.) (Fig. 73).

**Diagnosis.** A small *Euscorpium* species, total length 27–32 mm (average 28.5mm). Color of adults light brown to brown-reddish. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3}+Et_1$ ). The number of trichobothria on the pedipalp patella ventral surface is 7. The number of trichobothria on pedipalp patella external surface is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 3$ ,  $est = 4$ ,  $et = 5$ . The pectinal teeth number in males usually is 8, and in females usually 7. Mean  $Lchel/Wchel$  ratio is 2.4 in males and 2.5 in females. Dorsal patellar spur well-developed. Femur more or less as length as the patella, but tending to be less long ( $Lfem/Lpat$  ratio on average is 0.98). Carapace more or less as long as wide (average ratio  $Lcar/Wcar$  1). Mean ratio of  $Lmet/Lcar$  is 2.69 in males and 2.45 in females. Mean ratio  $Lmet/Wmet$  is 1.72 (1.63–1.92).

**Trichobothrial and pectinal teeth count variation.**

The variation observed in 28 examined specimens (15 ♂, 13 ♀) is given below.

**Pectinal teeth in males** (n=15): 7/7 (3), 8/8 (12); in total, 7 in 20 % (6), and 8 in 80 (24); mean = 7.8, SD = 0.41.



**Figures 57–58:** *Euscorpium ciliciensis* stat. n., female. **57.** Dorsal view. **58.** Ventral view.

*Pectinal teeth in females* (n=13): 6/6 (1), 6/7 (2), 7/7 (10); in total, 6 in 15.38 % (4), and 7 in 84.62 % (22); mean = 6.85, SD = 0.37.

*Pedipalp patella trichobothria Pv* (n=28): 6/6 (2), 6/7 (2), 7/7 (23), 7/8 (1); in total, 6 in 10.71 % (6) %, and 7 in 89.5 % (49); mean = 6.91, SD = 0.34.

*Pedipalp patella trichobothria Pe* (n=28): *et* = 5/4 (3), 5/5 (22), 5/6 (1), 6/5 (1), 6/6 (1); in total, 4 in 5.36 % (3), 5 in 87.5 % (49), and 6 in 7.14 % (4); mean = 5.02, SD = 0.35; in total, *est* = 4/4; *em* = 3/3; *esb* = 2/2; *eb<sub>a</sub>* = 4/4; *eb* = 4/4.

**Hemispermatorphore.** Both right and left hemispermatorphores of three specimens were studied. They have a well-developed lamina. The secondary acuminate process is well developed, formed with one or more tips. The internal projection distally with 5–7 tines in its crown. The number and the shape of tines of the crown and of the secondary acuminate process may vary between specimens and between the right and the left hemispermatorphores.

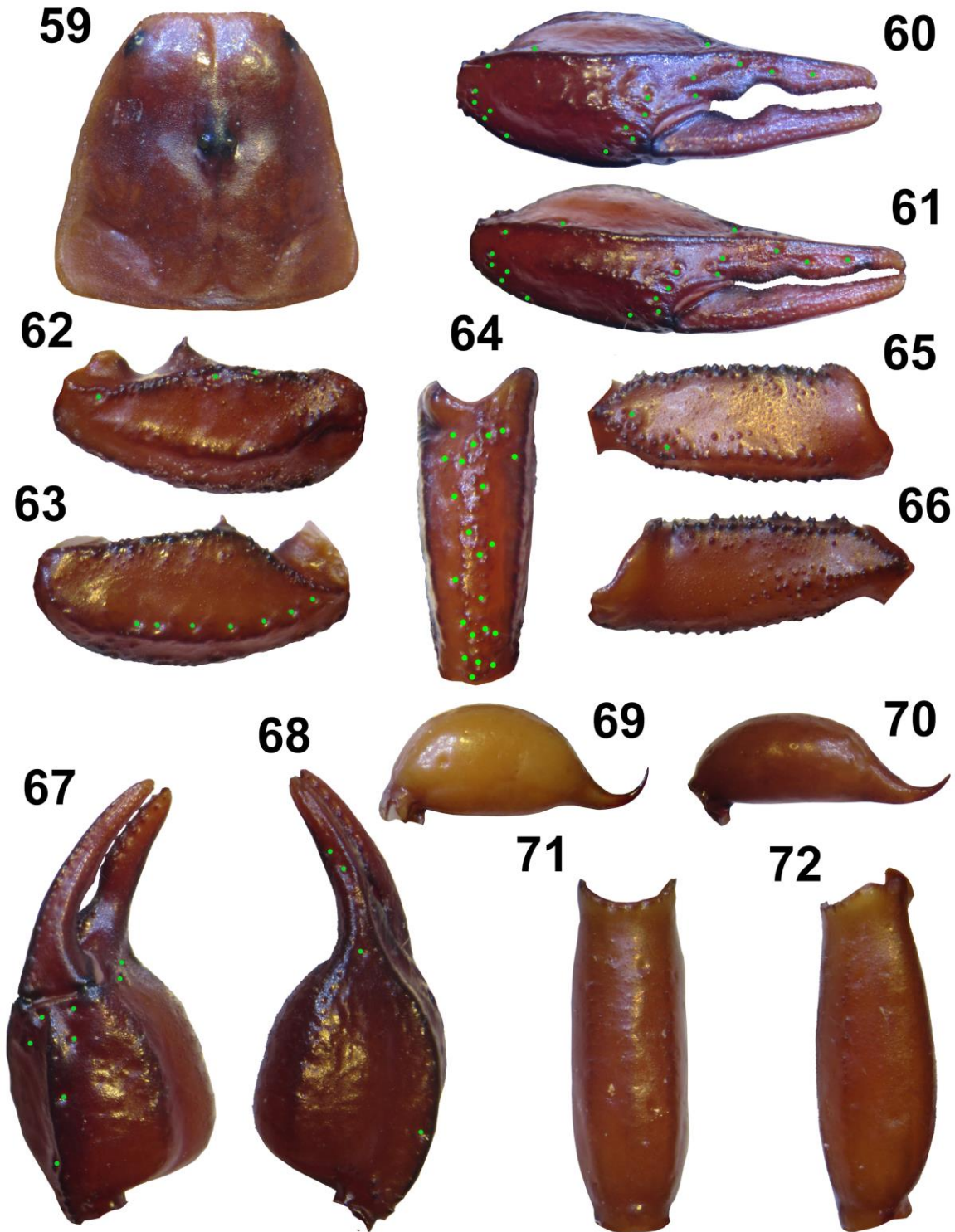
#### Description of a male (not a type)

**Coloration:** Entire body color light brownish/reddish with mesosoma lighter and carapace darker; sternites and pectines and genital operculum very light brownish/ivory; chelicerae yellowish without marbling; telson yellowish with dark reddish aculeus tip; all pedipalp carinae darker, dark brown to blackish colored.

**Carapace:** A fine granulation of homogeneous; anterior edge granulate and more or less straight; not deep posterior lateral furrows are present; two pairs of lateral eyes; a pair of median eyes is situated distally of the middle; distance from center of median eyes to anterior margin is 42.76 % of carapace length.

**Mesosoma:** Tergites very finely granulated; sternites glossy and punctated. Small spiracles inclined about 45° downward towards outside.

**Metasoma:** Dorsal carinae on segments I–IV with spaced, little pronounced granules; ventrolateral carinae on segment I absent, on I–IV obsolete or smooth; ventromedian carina absent on segments I–IV; on segment



**Figures 59–72:** *Euscorpium ciliciensis* stat. n., 59. Carapace. 60. External view of the chela of adult male. 61. External view of the chela of adult female. 62. Dorsal view of pedipalp patella. 63. Ventral view of pedipalp patella. 64. External view of pedipalp patella. 65. Dorsal view of pedipalp femur. 66. Ventral view of pedipalp femur. 67. Ventral view of the chela. 68. Dorsal view of the chela. 69. Telson of adult male. 70. Telson of adult female. 71. Ventral view of the metasomal segment V. 72. Lateral view of the metasomal segment V.

V small spaced granules are present on ventrolateral carinae; a true ventromedian carina is not visible, but just a slightly costate surface; dorsal and lateral intercarinal spaces with a very fine granulation, almost smooth on the ventral surface, except the segment V, which is granulated.

**Telson:** Vesicle almost smooth, with ventral setae of different size, especially near the vesicle/aculeus juncture.

**Pectines:** Teeth number 8/8; middle lamellae number 5/4; several microsetae on proximal area of teeth, marginal lamellae, middle lamellae and fulcra.

**Genital operculum:** The genital operculum is formed by two longitudinally separated subtriangular sclerites; genital papillae protruding; a few microsetae are present.

**Sternum:** Pentagonal shape, type 2; more or less as long as wide, with a deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal internal and ventral internal carinae tuberculated; dorsal external carinae formed by spaced tubercles; irregular ventral external carinae formed by tubercles of increasing size from distal to proximal area just on half of femur length; external median carinae formed by serrated tubercle; anterior median adjacent to ventral internal carinae, formed by conical and spaced tubercles of variable size; dorsal and ventral intercarinal spaces with granule of variable size. Patella: dorsal and ventral internal carinae granulated; dorsal external carinae rough; ventral external carinae from crenulated with little pronounced tubercle to rough; dorsal intercarinal surfaces granulated; ventral intercarinal surfaces from smooth to granulated near to ventral carinae. Dorsal patellar spur well developed. Chelal carina  $D_1$  is distinct, strong, dark and smooth;  $D_4$  is rounded and rough;  $V_1$  is distinct, strong, dark and smooth with a few tubercles proximally, following an oblique direction toward the inside of the trichobothrium  $Et_1$ ;  $V_3$  rounded, dark and rough; external carina granulated and rough; intercarinal tegument with granules positioned so as to form a reticulation; the fixed finger with notch, and movable finger with lobe distal compared to the center of the notch of the fixed finger. Finger dentition: In the most distal part is present a  $DD$  on the tip;  $MD$  is formed by very small denticles closely spaced forming a more or less straight line, discontinued at each 5–8 denticles at level of the  $OD$ , in proximal position the  $MD$  denticles is overlap forming two lines; fixed finger has 6  $OD$ , 6  $ID$ , and 6  $IAD$ ; movable finger has 7  $OD$ , 7  $ID$ , and 8  $IAD$ .

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 ( $V_{1-3} + Et_1$ ). Patella ventral ( $Pv$ ): 7/7. Patella external ( $Pe$ ):  $et = 5/5$ ,  $est = 4/4$ ,  $em = 3/3$ ,  $esb = 2/2$ ,  $eba = 4/4$ ,  $eb = 4/4$ . Femur: trichobothrium  $d$  is slightly proximal to  $i$ , while tricho-

bothrium  $e$  is distal to both  $d$  and  $i$ , and situated on dorsal external carina.

**Legs:** With two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 9/9 spinules, of increasing size from proximal to distal, ending with a slightly decentralized spinule; 3–4 main flanking tarsal setae present. Basitarsus with a few prolateral stout spinules on legs I and II, with just a spinule on legs II, and no spinules on legs IV; granulation well present on ventral and dorsal surface of all leg femora, it is mostly marked and dark ventrally.

**Chelicerae:** Movable finger: the dorsal distal denticle is much smaller than the ventral distal denticle; ventral edge is smooth with brushlike setae on the inner part; dorsal edge has five denticles: one large distal, two small subdistal, one large median, and a small basal. Fixed finger has four denticles: one distal, one subdistal, one median, and one basal, the last two in a fork arrangement; the internal surface has brushlike setae.

## Comments

*Euscorpium ciliciensis* was described by Birula (1898) as a species, based on two female specimens from Bulghar Dagh (=Bolkar Mt.), Taurus Mountains (see below). This species was considered a subspecies or synonym of *E. germanus* or *E. mingrelicus* (e.g. Di Caporiacco, 1950; Fet, 1989), but there was no detailed morphological study comparing these forms. Fet (1985) addressed *E. ciliciensis* stat. n. as transitional between “*E. germanus* complex” and “*E. mingrelicus* complex”, and indeed its diagnostic morphological characters are ambiguous. Some characters, such as trichobothrial series  $Pv = 7$ , the  $et-est/est-dsb$  ratio (0.95 to 1.55, mean 1.20), the telson being higher than wide in males, the light brown/reddish color, the carapace and metasoma ratio, are shared with some species of the subgenus *Euscorpium* (or related forms). This distinguishes *E. ciliciensis* stat. n. from the species of the subgenus *Alpiscorpium*. On the other hand, other characters like the trichobothrial series  $em = 3$ , and the configuration of the chelal carina  $VI$  (which follows in oblique direction toward the inside of the trichobothrium  $Et_1$ , and then becomes forked) put this species closer to *Alpiscorpium*. However, the subgeneric placement of *E. ciliciensis* is even more problematic since the abovementioned characters are not limited to subgenera *Euscorpium* s.str. or *Alpiscorpium*. E.g., both *E. carpathicus* (L., 1767) and *E. drenskii* Tropea et al., 2015 exhibit  $em = 3$  as a fixed character, while *E. giachinoi* Tropea et al., 2015 has a forked  $VI$  carina (Tropea et al., 2015; Tropea & Fet, 2015). Thus, at this moment *E. ciliciensis* is well separated by morphological characters as a valid species from *E. mingrelicus* and related forms, but its subgeneric placement is impossible.



	<i>E. ciliciensis</i> stat. n.	<i>E. mingrelicus</i>	<i>E. phrygius</i> stat. n.	<i>E. uludagensis</i> stat. n.
<b>Total size</b>	27–32 (28.57) {1.48}	27–42 (31.64) {5.06}	20–27 (24.14) {2.18}	21–26 (22.87) {1.69}
<b>Lmet/Wmet</b>	1.63–1.92 (1.72) {0.08}	1.51–1.71 (1.61) {0.06}	1.29–1.46 (1.37) {0.04}	1.33–1.50 (1.42) {0.05}
<b>Lfer/Lpat</b>	0.96–1.00 (0.98) {0.03}	0.96–1.04 (0.95) {0.05}	0.90–0.96 (0.93) {0.05}	0.91–0.95 (0.94) {0.05}
<b>Htel/Wtel</b> ♂	1.02–1.20 (1.10) {0.09}	0.83–0.97 (0.91) {0.11}	0.82–0.95 (0.88) {0.10}	0.87–0.92 (0.90) {0.04}
<b>Htel/Wtel</b> ♀	0.95–1.00 (0.97) {0.08}	0.69–0.96 (0.85) {0.11}	0.77–0.82 (0.81) {0.11}	0.81–0.89 (0.86) {0.11}
<b>Lmet/Lcar</b> ♂	2.64–3.04 (2.72) {0.13}	2.53–3.07 (2.85) {0.15}	2.66–2.85 (2.77) {0.07}	2.65–2.89 (2.79) {0.09}
<b>Lmet/Lcar</b> ♀	2.37–2.52 (2.45) {0.10}	2.46–2.75 (2.60) {0.15}	2.45–2.65 (2.52) {0.07}	2.45–2.59 (2.52) {0.05}
<b>L/W met.seg V</b>	2.85–3.48 (3.08) {0.17}	2.62–3.24 (2.90) {0.15}	2.13–2.62 (2.43) {0.12}	2.28–2.70 (2.55) {0.15}

**Table 2:** Selected ratios and measurements that highlight the differences and similarities of the species discussed in this paper; max-min (mean) {SD}.

Species	<i>Dp</i> ♂	<i>Dp</i> ♀	<i>Pv</i>	<i>Pe-et</i>
<i>E. ciliciensis</i> stat. n.	7–8 (7.80) {0.41}	6–7 (6.85) {0.37}	6–8 (6.91) {0.34}	4–6 (5.02) {0.35}
<i>E. mingrelicus</i>	7–10 (8.49) {0.58}	5–8 (6.52) {0.60}	5–8 (6.00) {0.38}	4–6 (4.96) {0.41}
<i>E. phrygius</i> stat. n.	8–10 (8.83) {0.44}	6–8 (6.79) {0.46}	5–7 (6.01) {0.20}	4–5 (4.09) {0.33}
<i>E. uludagensis</i> stat. n.	8–10 (8.83) {0.51}	6–7 (6.53) {0.51}	5–6 (5.05) {0.36}	3–4 (3.98) {0.12}

**Table 3:** Pectinal tooth and trichobothrial *Pv* and *Pe-et* counts of *Euscorpius* species discussed in this paper; max-min (mean) {SD}.

It should be noted that Fet et al. (2003) showed a preliminary phylogenetic tree, which included *E. ciliciensis* from two localities forming a clade with *E. germanus* and *E. gamma*, divided from another clade formed by (*E. italicus*, *E. carpathicus*, and *E. candiota*). The results could suggest that *E. ciliciensis* is related to the species of *Alpiscorpius*, without a definite subgeneric placement. Pending more information on its phylogenetic relationships, and due to its morphological ambiguity, we do not assign *E. ciliciensis* stat. n. in any subgenus in this paper.

### Ecological Notes

*E. ciliciensis* is found in cool habitats at high attitudes, from 1000 to 2600 m. The locality in the Bolkar Mountains is characterized by thorny bush vegetation adapted to cold environment. Specimens were collected at night inside rock cracks, or roadside stone wall cracks as well as in exposed areas, on rock surfaces, and on the roads. They probably absorb heat from such substrates to be active in night.

Syntypes published by Birula were only two females (ZISP 956) from Bulghar Dagh, collected by M. Holtz in 1897. An additional four specimens (2 males, 1 females and 1 juv., ZISP 957), reported by Fet (1985) and Fet & Sissom (2000), are not syntypes but have a more detailed label, “Bulghar Dagh, Kara Göl, 2600 m, August 1897, M. Holtz.” Karagöl, or Maden Lake, therefore, is close to an unspecified type locality. The second author (E.Y.) collected *E. ciliciensis* from Darboğaz (2400 m) (Fig. 80) to Karagöl Lake (2600 m) (Fig. 81), and at an

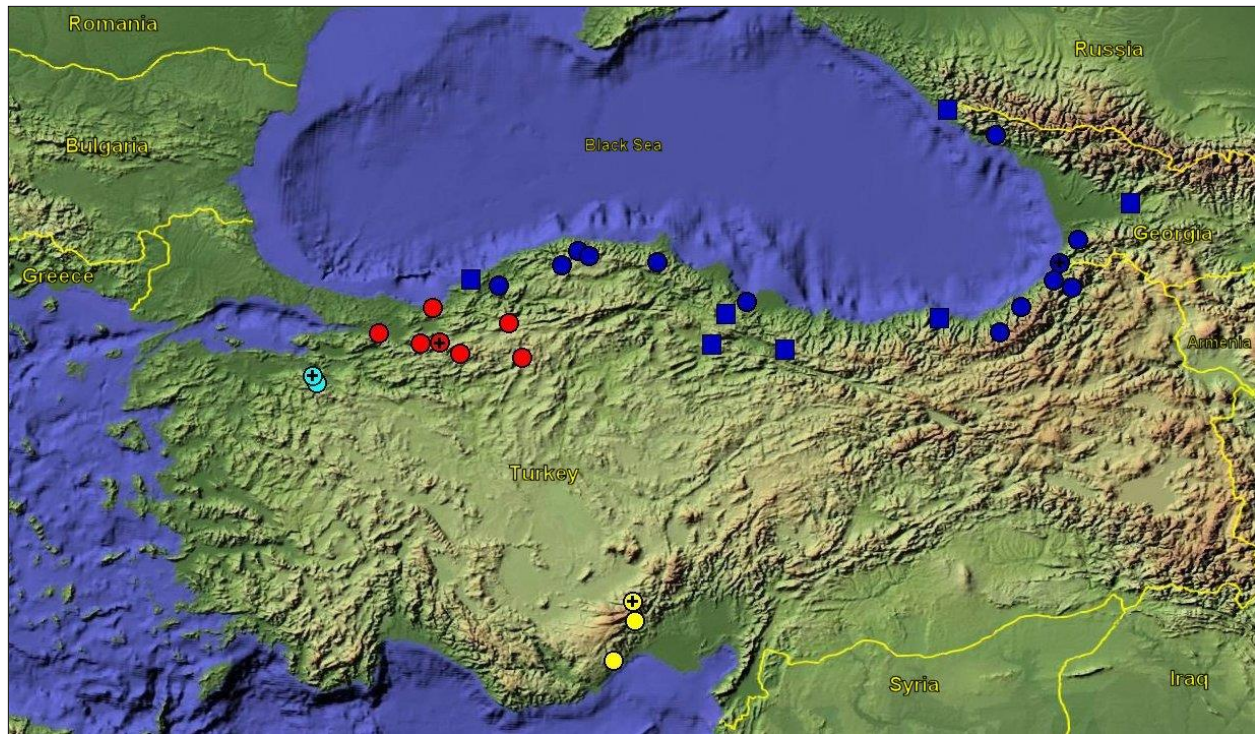
overlooking hill up to 2700 m. This is the highest known altitude for the genus *Euscorpius*.

Collections of Martin Holtz from the Cilician Taurus yielded many other important animal species. Among them were an iurid scorpion *Protoiurus asiaticus* (Birula, 1903) from Gülek Pass (Kovářík et al., 2010) as well as a highly endangered Taurus frog, *Rana holtzi* Werner, 1898 (Werner, 1898; Kaya et al., 2005).

### Notes on two old diagnostic characters

#### (a) Fixed finger et-est/est-dsb ratio.

This character was introduced by Bonacina (1980) who for the first time reported that *E. germanus* (which then also included *E. alpha*) had *et-est/est-dsb* ratio about 1, while his *E. mingrelicus* had ratios 1.5 to 3. He used this character also to distinguish the subspecies *E. m. caporiaccoi* Bonacina, 1980; later, Fet (2000) used it to distinguish *E. beroni*. While this character appears to separate the informal “*E. germanus* complex” from “*E. mingrelicus* complex”, it does not seem suitable to distinguish between their species, because of the high variability and overlap in the values. Our data are more or less in accordance with those of Bonacina (1980). In *E. germanus* specimens that we studied, a mean ratio was 1.16, with a range of 0.90–1.33. Within the Anatolian-Caucasian species, we determined a wide variation as follows: *E. phrygius*, 1.93, with a range of 1.42–2.43; *E. uludagensis*, 2.42, with a range of 1.82–3.23; *E. mingrelicus*, 1.79, with a range of 1.39–2.2. Fet (1993) gives means for three separate Caucasian populations of *E. mingrelicus* from 1.69 to 1.96. In *E.*



**Figure 73:** Geographic distribution of the species treated in this paper. *Euscorpius phrygius* stat. n., red; *E. uludagensis* stat. n., turquoise; *E. mingrelicus*, blue; and *E. ciliciensis*, yellow. Circles, localities of examined specimens; squares, localities from Bonacina (1980), Fet (1993), and Lacroix (1995). Type localities are indicated with a "+" inside the circles.

*ciliciensis* (not examined by Bonacina), the ratio varied widely, with a range 0.95–1.54, and a mean of 1.20.

(b) *Configuration of the chelal trichobothria*  $V_{1-3}$

Lacroix (1995) introduced, as a new diagnostic character, the shape of an imaginary line connecting the chelal trichobothria  $V_1$ ,  $V_2$ , and  $V_3$ . Using two alternative character states ("straight" or "broken" line), he distinguished the forms with the same number of patellar trichobothria: *E. m. ollivieri* (Turkey, "straight" line) from *E. m. mingrelicus* (Caucasus, "broken"), and *E. m. legrandi* ("straight") from *E. m. phrygius* ("broken").

However, Lacroix did not provide any figures, or particular details on how the line shape was documented; we can presume that the position of trichobothria  $V_2$  could vary. Lacroix did not mention if all his specimens exhibited these characters; and he only studied three specimens (two adults and a juvenile) of *E. m. legrandi*, and four specimens of *E. m. phrygius*.

We tested, using an ocular micrometer, samples of specimens of both sexes from different populations to understand whether this character is reliable. Among *E. mingrelicus* from Turkey, Kastamonu Province (n=25), 11 had "straight" line, and 15, "broken"; Turkey, Rize Province (n=26): 10 had "straight" line, and 16, "broken"; Georgia, Kobuleti (n=28): 9 had "straight" line, and 19, "broken". It is clear that extensive variation

in this character is present in both Turkish and Caucasian populations of *E. mingrelicus*, contrary to what Lacroix (1995) stated.

For *E. m. legrandi*, we were able to score this character only in the two adult and a juvenile syntypes, of which only the adult male had a "straight" line. At the same time, only 6 out of 28 specimens of *E. phrygius* had "straight" line.

As far as we can see, both states were observed, with the "broken" line dominating in each studied population of *E. mingrelicus* as well as in *E. phrygius*. We do not see any populations fixed for this character. According to Lacroix, this is the only character that distinguishes *E. m. ollivieri* from *E. m. mingrelicus*, and *E. m. legrandi* from *E. phrygius*. Indeed, we have not found any other characters to differentiate these forms; thus we consider *E. m. ollivieri* a synonym of *E. mingrelicus*, and *E. m. legrandi* a synonym of *E. phrygius* stat. n.

**Identification key for the Anatolian-Caucasian  
*Euscorpius* species with  $em = 3$**

1. Trichobothrial series on pedipalp patella external surface  $et = 4$  (Figs. 10, 28); small *Euscorpius* (23–27 mm); very stocky metasoma,  $Lmet/Wmet < 1.51$  ..... 2



**Figures 74–75:** Natural habitat of *Euscorpius phrygius* in Turkey. **74.** Ankara Province: Kızılcahamam, Göllü area. **75.** Bolu Province: Mudurnu, Sülüklü lake road.



**Figures 76–77:** Natural habitat of *Euscorpius uludagensis* in Turkey. *Bursa Province*: Uludağ Mts., Barakli Lake.



**Figures 78–79:** Natural habitat of *Euscorpius mingrelicus* in Turkey. Artvin Province: Artvin, Hatila Valley.



**Figures 80–81:** Natural habitat of *Euscorpius ciliciensis*. Niğde Province, Bolkar Mts. **80.** Darboğaz. **81.** Karagöl (Maden Lake).

– Trichobothrial series on pedipalp patella external surface  $et = 5-6$  (Figs. 46, 64); medium-small to large *Euscorpium* (27–42 mm);  $Lmet/Wmet > 1.5$  ..... **3**

**2.**  $P_v = 6$  (Fig. 9)..... *E. phrygius* stat. n.

–  $P_v = 5$  (Fig. 27); inhabits the Uludağ Mts. ....  
..... *E. uludagensis* stat. n.

**3.** Usually  $P_v = 6$  (Fig. 45); dark brown; telson wider than high in both males and females ( $H_{tel}/W_{tel} < 1$ ); inhabits the areas along the Black Sea coast.....  
..... *E. mingrelicus*

–  $P_v = 7$  (Fig. 63); light brown-reddish; telson higher than wide in males ( $H_{tel}/W_{tel} \geq 1$ ); inhabits the Taurus Mts. ....  
..... *E. ciliciensis* stat. n.

## Conclusions

In this study, we have reconsidered the status of the Anatolian-Caucasian taxa of the informal “*E. mingrelicus* complex”, based on old and new diagnostic characters. All these subspecies have been reviewed and compared for the first time since they have been described. Our results reveal four valid species, with a clear morphological division between *E. mingrelicus*, *E. phrygius* stat. n. + *E. uludagensis* stat. n., and *E. ciliciensis* stat. n.

The range of *E. mingrelicus* covers an extensive area in northern Anatolia between the Black Sea and Pontic Mountains, and stretches northwest along the Black Sea coast as far as Russia. Considering the high local endemism in the genus *Euscorpium* in mountainous regions, further investigations, especially a detailed phylogeographic analysis, are needed to further clarify the relationships of populations within *E. mingrelicus*. A clear division between *E. mingrelicus* and *E. phrygius* + *E. uludagensis* could be due to the role of the Pontic Mountains as an important natural barrier dividing these two groups for a long time.

We confirm, after a long period of indecision, the status of *E. ciliciensis* as a valid species; however, its relationships remain enigmatic and its ambiguous features currently do not allow a confident subgeneric placement.

Further studies, especially based on DNA markers, are required to better understand the relationships between the Anatolian-Caucasian populations of the “*E. mingrelicus* complex”, as well as those remaining unresolved in the Balkans.

## Acknowledgments

We wish to thank the following people who kindly provided specimens for this study: Abdulmuttalip Ak-

kaya, Pierangelo Crucitti, Tarık Danişman, Gérard Dupré, Jürgen Gruber, Luis Guariento, Christoph Hörweg, Raşen S. Kaya, Altuğ Kızıltuğ, Yusuf Kumlutaş, Kadir Boğaç Kunt, Maurizio Mei, Paolo Pantini, Marco Uliana, and Marco Valle. We are especially indebted to Gérard Dupré who donated to V.F. part of the collection of the late J.-B. Lacroix, including important type specimens; and to Alberto Bonacina whose pioneering work encouraged further studies of the revised taxa. E.Y. also thanks Halil Koç for his help in the field.

V. F. is grateful to his late friend and mentor Gary A. Polis who kindly donated a Coleman Safari UV light used in August 1985 to collect *Euscorpium mingrelicus* in Batumi, Georgia (including the neotype); to Sergei Golovatch (Moscow) and Nadezhda Skalon (Barnaul) who hand-carried this light from Europe to Russia and then to Turkmenistan; and to Vladimir Fet for his company in that field trip 30 years ago.

Evgeni Zhukovets (Minsk) kindly helped V. F. to investigate the Jelski biography.

We thank two anonymous reviewers for their suggestions.

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