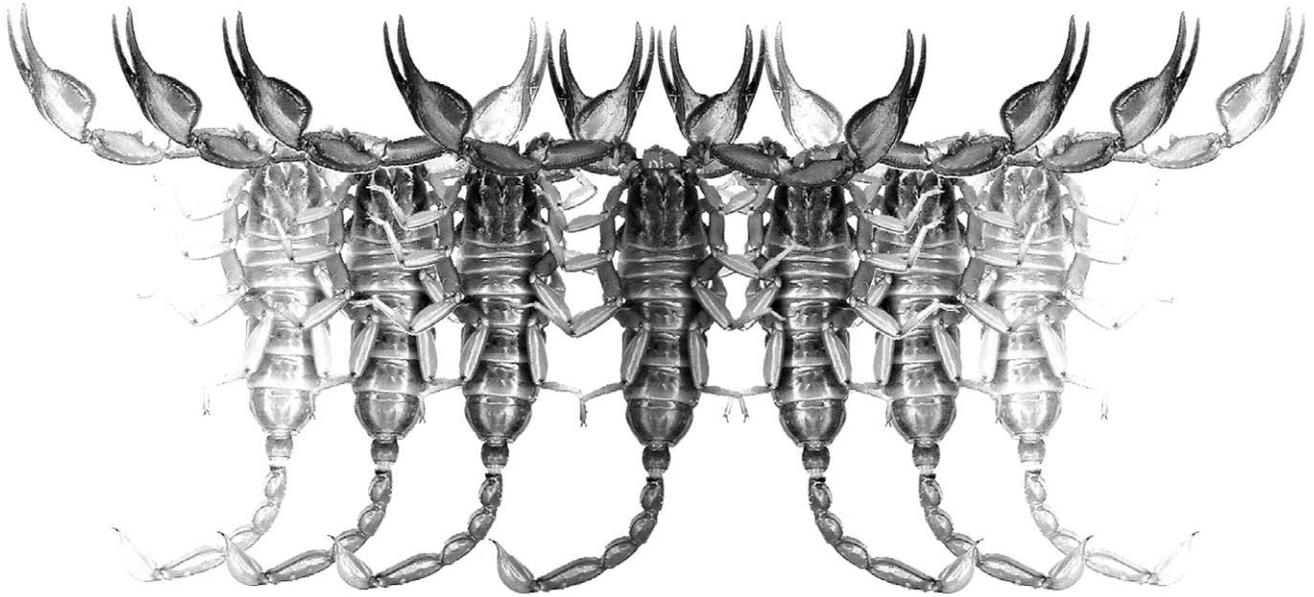


Euscorpium

Occasional Publications in Scorpiology



**Two New Species of *Euscorpium* Thorell, 1876 from
Southern Turkey (Scorpiones: Euscorpidae)**

Gioele Tropea & Ersen Aydın Yağmur

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Euscorpius

Occasional Publications in Scorpiology

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The name *Euscorpius* Thorell, 1876 refers to the most common genus of scorpions in the Mediterranean region and southern Europe (family Euscorpiidae).

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<http://www.zoobank.org/urn:lsid:zoobank.org:pub:2293F80B-6BB6-4696-A44B-40BB72FDDB10>

Two new species of *Euscorpius* Thorell, 1876 from southern Turkey (Scorpiones: Euscorpiidae)

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<http://www.zoobank.org/urn:lsid:zoobank.org:pub:2293F80B-6BB6-4696-A44B-40BB72FDDB10>

Summary

Two new species of scorpion of the genus *Euscorpius* Thorell, 1876 are described from southern Turkey based on morphological ratio and trichobothrial data. *E. hakani* sp. n. from Mt. Eşeler, in Denizli Province in southwestern Turkey and *E. aladaglarensis* sp. n. from the Aladağlar Mts., in Niğde, Kayseri, and Adana Provinces. With the description of two new taxa, 17 species of *Euscorpius* are currently recognized in Turkey.

Introduction

The genus *Euscorpius* Thorell, 1876 is one of the most studied groups of scorpions. It is very common in southern Europe and Anatolia, and its species occupy diverse habitats from the sea level up to over 2,700 m a.s.l. (Tropea et al., 2015b; data published herein). Taxonomy of this genus is complicated and still unresolved throughout its range. In the last years our group has been intensively studying the genus *Euscorpius* in Turkey, resulting in a significant increase of the number of species in this country. Since 2012 the number of Turkish species have increased from 2 to 15, not including the new species described here (Tropea & Yağmur, 2015, 2016; Tropea et al., 2012, 2014a, 2015b, 2016a, 2016b; Yağmur & Tropea, 2013, 2015; Yağmur et al., 2013). In addition, recently Fet et al. (2016) published a phylogeny of populations related to the subgenus *Alpiscorpius* Gantenbein et al. (1999) in Turkey. In this paper, as part of an ongoing study of the genus *Euscorpius* in Turkey, we describe two new *Euscorpius* species, *E. hakani* sp. n. and *E. aladaglarensis* sp. n., based on morphological ratio and trichobothrial data. This increases to 17 the number of *Euscorpius* species currently recognized in Turkey, of which 10 are related to the subgenus *Alpiscorpius*.

Material and Methods

The trichobothrial notation follows Vachon (1974). Morphological measurements are given in millimetres (mm) following Tropea et al. (2014a) but we use *Wchel*

= *Wchel-A*. Morphological nomenclature follows Stahnke (1971), Hjelle (1990), and Sissom (1990); the chela carinae and denticle configuration follows Soleglad & Sissom (2001) but we united *ID+IAD*; and sternum terminology follows Soleglad & Fet (2003). The map was generated using Earth Explorer 6.1.

Abbreviations

Dp: pectinal teeth number; *Wchel*: chela width (= *Wchel-A* of Tropea et al. 2014a); *CarA/CarP* %: average ratio of distances from centre of median eyes to anterior and posterior margins of the carapace; *DPS*: dorsal patellar spur; *imm.*: immature specimen (in any stage of development).

Depositories: AZMM, Alaşehir Zoological Museum, Celal Bayar University, Alaşehir, Manisa, Turkey; GTC, personal collection of Gioele Tropea, Rome, Italy.

Material Studied

A detailed list of the material with label data is provided below under each species. Further specimens examined for comparison are listed below:

E. arikani: Turkey, Antalya Province, Finike District, Alacadag Mt., Eroğlu Hill, 36°26'12"N, 30°02'22"E, 18 September 2014, leg. E. A. Yağmur & A. Avcı, ♂ holotype (AZMM); as holotype, 6 ♂, 12 ♀ paratypes (GTC).

E. ciliciensis: Turkey, Niğde Province, Ulukışla District, Bolkar Mts., 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).

E. eskisehirensis: Turkey, Eskişehir Province, Alpu District, Çatacık Forest, 1556 m, 39°57'59" N, 31°08'02" E, 1 July 2012, leg. E.A. Yağmur, R. Kaya & H. Koru, 1 ♂ (AZMM holotype); same data, 8 ♂, 20 ♀ (GTC); Turkey, 25 km W from Mihaliççık, 890 m, 39°50'05" N, 31°11'36" E, 27 September 2010, leg. R. Kaya & K.B. Kunt, 2 ♂, 1 ♀ (GTC).

E. honazicus: Turkey, Denizli Province, Mt. Honaz, 2500 m a.s.l., 37°40'37.6"N, 29°17'10.6"E, 13 June 2013, leg. E.A. Yağmur, ♂ holotype (AZMM); data as for holotype, 6 ♂, 8 ♀ paratypes (GTC).

E. mingrelicus: Georgia, Tskhemvani, in the Kintrishi Protected Area, Kobuleti, 41°47'25.1"N, 41°57'36.8"E, leg. P. Crucitti, 4 ♂, 4 ♀ (GTC); Turkey, Artvin, Hatila Valley, 25 July 2011, leg. E.A. Yağmur, 1 ♂, 1 ♀ (GTC).

E. phrygius: Turkey, Bolu Province, Abant District, 12 August 1972, leg. A. Valle, 1 ♂ lectotype (MSNB 9125); same label as lectotype, 2 ♂, 2 ♀ paralectotypes (GTC).

E. sultanensis: Turkey, Sultan Mountains (Sultan Dağları), near the border between Afyonkarahisar and Konya Provinces, 38°26'03.4"N, 31°15'00.4"E, 1914 m a.s.l., 20 June 2013, leg. E.A. Yağmur & S. Örgel ♂ holotype (AZMM). data as for holotype, 3 ♂, 3 ♀ paratypes (GTC); as holotype but 38°26'05.1"N, 31°15'00.0"E, 1906 m a.s.l., 21 June 2013, leg. E.A. Yağmur, 1 ♀ paratype (AZMM); Turkey, Afyonkarahisar Province, Sultan Mountains, 28 May 2004, leg. H. Koç, 2 ♀ paratypes (data as for AZMM).

E. uludagensis: Turkey, Bursa Province, Uludağ Mt., Alacan Village, leg. E.A. Yağmur, 1 ♂, 1 ♀ (GTC); Turkey, Keles, Uludağ Mt., 1293 m a.s.l., 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).

Systematics

Family **Euscorpiidae** Laurie, 1896

Genus **Euscorpius** Thorell, 1876

Subgenus **Incertus**

***Euscorpius aladaglarensis* Tropea et Yağmur, 2016, sp. n.**

(Figs. 1–20, Table 1)

<http://www.zoobank.org/urn:lsid:zoobank.org:act:12C8B7B1-9A0B-4D6F-8685-369CA5E4E051>

Type material (56 specimens: 24 ♂ and 32 ♀). **Holotype**: ♂, Turkey, Niğde Province, Çamardı District, Aladağlar Mountains, 2212 m, 37°49'18"N, 35°07'09"E, 3 June 2016, leg. E.A. Yağmur, S. Örgel & S. Yaman (AZMM). **Paratypes**: data as for holotype, 14 ♂, 16 ♀ (AZMM); data as for holotype, 9 ♂, 12 ♀ (GTC); Tur-

key, Kayseri Province, Yahyalı District, Aladağlar Mountains, 2757 m a.s.l., 37°56' 1.3"N, 35°15' 23.7"E, 5 June 2016, leg. E.A. Yağmur, S. Örgel & S. Yaman, 1 ♂, 2 ♀ (AZMM); Turkey, Niğde Province, Çamardı District, Aladağlar Mountains, Emli Valley, 2000 m a.s.l., 37°45'59"N, 35°07'55"E, 19 May 2010, leg. E.A. Yağmur, 1 ♀ (AZMM); Turkey, Niğde Province, Çamardı District, Aladağlar Mountains, from Sokullupınar to Karayalak Valley, 2121 m a.s.l., 37°49'00"N, 35°06'50"E, 13 August 2010, leg. E.A. Yağmur, 1 ♀ (AZMM).

Geographic range. Southern Turkey: Niğde, Kayseri, and Adana Provinces (Fig. 44).

Etymology. The specific epithet is derived from the name of Aladağlar Mountains, a mountain range in Niğde, Kayseri, and Adana Provinces.

Diagnosis. A medium-small *Euscorpius* species, total length 27–33 mm. Color of adults is light brown to medium brown-reddish without dark marbling on chelicerae. The number of trichobothria on the pedipalp manus ventral surface is 4 ($V1-3+Et_1$). Trichobothrium *et* on fixed finger is located distally to the notch of the fixed finger, *est* is located distally the centre of the notch, and *dsb* is located proximally to *est* and the notch. The number of trichobothria on the pedipalp patella ventral surface most is 7 (6–8). The number of trichobothria on pedipalp patella external surface most is: *eb* = 4, *eba* = 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 6 (5–7). Trichobothrium *i* of the femur is slightly distal to *d*. The pectinal teeth number in males usually is 8, and in females usually 7. Carina *V1* follows an oblique direction toward the inside of the trichobothrium *Et_1*. Dorsal patellar spur well-developed. Metasoma segment V from almost smooth to with a few small spaced granule, mostly ventrolaterally.

Trichobothrial and pectinal teeth count variation

The variation observed in 56 examined specimens (24 ♂ and 32 ♀) is given below.

Pectinal teeth in males (n=24): 7/7 (1), 7/8 (1), 8/8 (19), 8/9 (1), 9/8 (1), 9/9 (1); in total, 7 in 6.25 % (3), 8 in 85.42 % (41), 9 in 8.33 % (4) and 10 in 2.08 % (1/24); mean = 8.06, SD = 0.47.

Pectinal teeth in females (n=32): 6/6 (1), 6/7 (3), 7/6 (2), 7/7 (24), 7/8 (1), 8/7 (1); in total, 6 in 15.6 % (7), 7 in 85.94 % (55) and 8 in 3.12 % (2); mean = 6.92, SD = 0.37.

Pedipalp patella trichobothria Pv (n=56): 6/6 (3), 6/7 (1), 7/6 (3), ?/7 (1), 7/7 (44), 7/8 (4); in total, 6 in 8.93 % (10), 7 in 86.61 % (97) and 8 in 3.57 % (4); mean = 6.95, SD = 0.35.



Figures 1–2: *Euscorpius aladaglarensis* sp. n., male, dorsal and ventral views.



Figures 3–4: *Euscorpius aladaglarensis* sp. n., female, dorsal and ventral views.

Pedipalp patella trichobothria Pe (n=56): *et* = 5/5 (8), 5/6 (3), 6/5 (5), 6/6 (37), 6/7 (1), 7/6 (2); in total, 5 in 21.43 % (24), 6 in 75.9 % (85) and 7 in 2.68 % (3); mean = 5.81, SD = 0.45; *em* = 2/4 (1), 4/3 (2), 4/4 (53); in total, 4 in 98.21 % (109); mean = 3.96, SD = 0.23; *est* = 3/4 (2), 4/3 (2), 4/4 (52); *esb* = 2/2 (56); *eb_a* = 4/4 (56); *eb* = 4/4 (56).

Description holotype

Coloration. Entire body light brownish colored with carapace and pedipalps darker, light brownish/reddish; sternites and pectines and genital operculum very light brownish/ivory; chelicerae very light yellowish without marbling; telson yellowish with dark reddish aculeus tip;

legs yellowish; all pedipalp carinae darker, dark brown to blackish colored.

Carapace. A more or less homogeneous size granulation is present; anterior edge straight; posterior lateral, posterior median, and anterior median furrows are present; two pairs of lateral eyes, and a pair of median eyes, situated distally of the middle; distance from centre of median eyes to anterior margin is 41.93 % of carapace length.

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

Metasoma. Dorsal carinae on the segments I–IV with spaced, little pronounced granules; ventrolateral carinae on the segment I absent, on the segments I–IV absent or obsolete; ventromedian carina absent on the segments I–IV; on segment V small spaced granules are present on ventrolateral carinae; barely visible ventromedian carina, formed by a slight angularity and a few small spaced granules; dorsal intercarinal spaces with a very fine granulation, smooth or almost smooth on the ventral and lateral surface.

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

Pectines. Teeth number 8/8; middle lamellae number 4 or 5/4 or 5; 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 well formed by serrated tubercle just on half of femur length; 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 formed by low and irregular granules and tubercles; dorsal external carinae rough and dark and well formed almost in all its long, it becomes thinner and less dark towards the proximal part up until reaching the clear base color; ventral external carinae from crenulated to rough; intercarinal surfaces with fine granules. Dorsal patellar spur well developed. Chelal carina *D1* is distinct, strong, dark and smooth; *D4* is rounded and smooth; *V1* is distinct, strong, dark and smooth with a few tubercles proximally, following an oblique direction toward the inside of the trichobothrium *Et1*; *V3* rounded, dark and smooth; external carina from

granulated to 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 centre 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 6–8 denticles at level of the *OD*; fixed finger has 6 *OD* and 11 *ID*; movable finger has 7 *OD* and 14 *ID*.

Trichobothria. Chela: trichobothria on the pedipalp manus ventral surface $V = 3/3 (V_{1-3}) + Et_1 = 1/1$; trichobothrium V_4 situated on the external surface of the chela near to the carina V_i ; trichobothrium on fixed finger *est* situated in distal half of the notch of the fixed finger; *et–est/est–dsb* trichobothrial ratio different from right and left chelae with 1.82 to right and 1.38 to left. Patella ventral (*Pv*): 7/7. Patella external (*Pe*): *et* = 6–6, *est* = 4/4, *em* = 4/4, *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 10/10 spinules, of increasing size from proximal to distal, ending with both decentralized spinule and with a pair to form a "Y"; 3 main flanking tarsal setae present. Granulation well present on ventral and dorsal surface of all leg femora, it is mostly marked and dark ventrally.

Chelicerae. Typical of the genus *Euscorpius*.

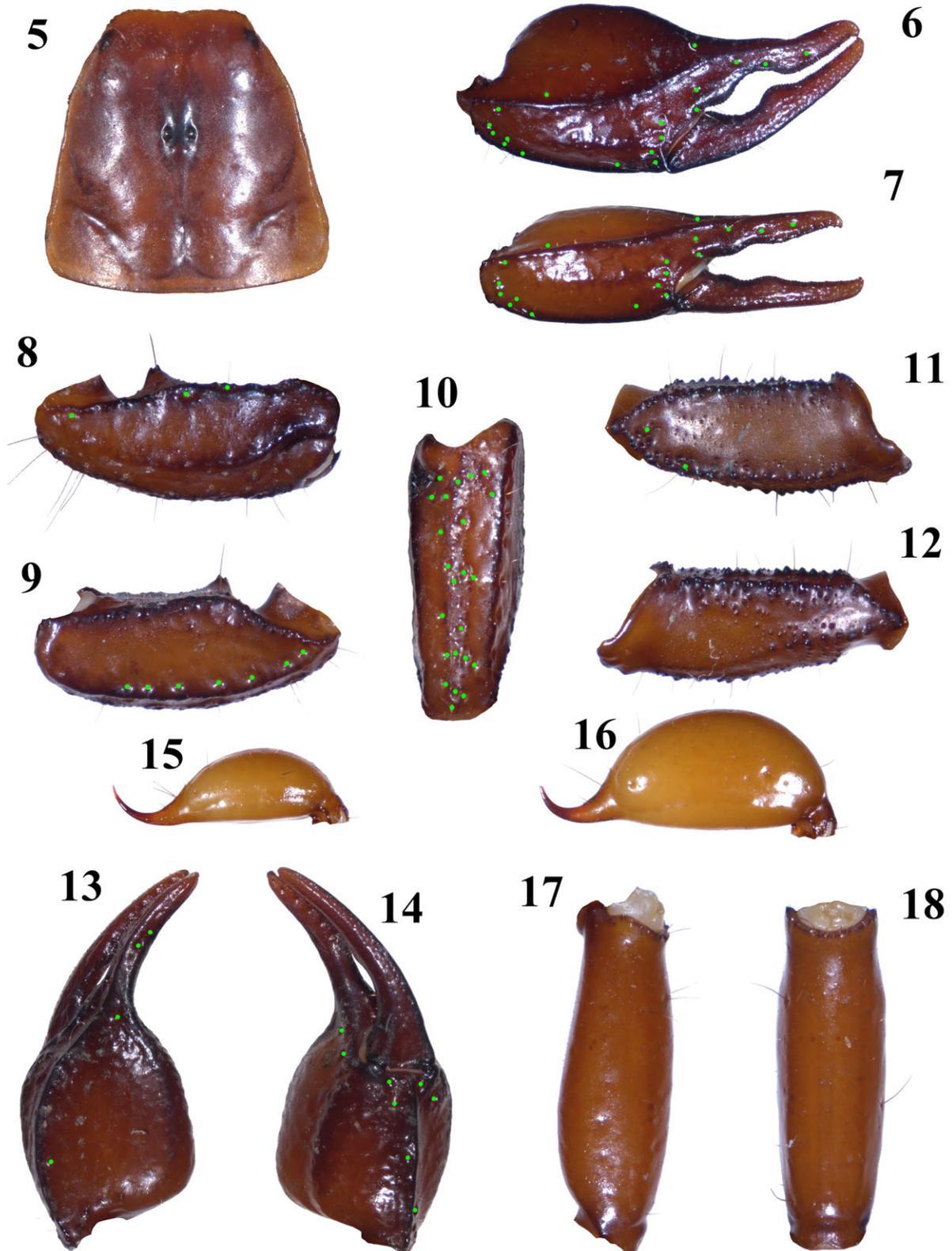
Ecological notes

E. aladaglarenensis sp. n. specimens were found in cool habitats at high altitude, from 2000 m to 2717 m, becoming the *Euscorpius* species founds to the high altitude. The locality in the Aladağlar Mountains is characterized by scattered thorny bush vegetation adapted to cold environment and grasses (Fig. 21). Specimens were collected at the day time under stones. Three specimens were collected very close to patches of snow next to a cairn (Fig. 22).

Distinction of *E. aladaglarenensis* sp. n. from other Turkish *Euscorpius* species

In Turkey there are sixteen species of the genus *Euscorpius* (not including *E. aladaglarenensis* sp. n.), all morphologically and/or geographically well distinguishable from *E. aladaglarenensis* sp. n.

E. aladaglarenensis sp. n. has the trichobothrial series $V = 3$, which easily distinguishes it from *E. italicus*, and the series on the pedipalp patella external surface $em = 4$, that distinguishes it from the phylogenetically related species, which usually have $em = 3$. *E. aladaglarenensis* can be easily distinguished from the, phylogenetically



Figures 5–18: *Euscorpium aladaglarenis* sp. n. 5. Carapace. 6. External view of chela of adult male. 7. External view of 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. Dorsal view of chela. 14. Ventral view of chela. 15. Telson of adult female. 16. Telson of adult male. 17. Lateral view of the metasomal segment V. 18. Ventral view of the metasomal segment V.



Figures 19–20: Live specimens of *Euscorpius aladaglarensis* sp. n. in natural habitat 19. Male. 20. Female.



Figures 21–22: Habitat where the specimens of *E. aladaglarenis* sp. n. were collected.

distant, other species with the series trichobothrial $em = 4$, mainly and easily, for the carina $V1$; in *E. aladaglarenensis* sp. n. it follows an oblique direction toward the inside of the trichobothrium $Et1$, while in the other species with $em = 4$, this carina follows a direction toward the external of the trichobothrium $Et1$.

The species phylogenetically, morphologically and geographically closest to *E. aladaglarenensis* is *E. ciliciensis*. These two species are mainly distinguishable by a different number of trichobothria on the pedipalp patella external surface series et and em ; *E. aladaglarenensis* has $et = 6$ (in 76% of pedipalps examined) and $em = 4$ (in 97.3% of pedipalps examined), while *E. ciliciensis* has $et = 5$ (in 87.5 of pedipalps examined by Tropea et al., 2015b) and $em = 3$ (in 100% of pedipalps examined by Tropea et al., 2015b).

Subgenus Incertus

Euscorpius hakani Tropea et Yağmur, 2016, sp. n.

(Figs. 23–42, Table 1)

<http://www.zoobank.org/urn:lsid:zoobank.org:act:416402AA-DB6E-4CA9-8B45-3DFAD4304B91>

Type material (55 specimens: 19 ♂ and 36 ♀). **Holotype**: ♂, Turkey, Denizli Province, Bozkurt District, Mt. Eşeler, above 1700 m a.s.l., around 37°42'55.5"N, 29°29'31.3"E, 15 June 2013, leg. E.A. Yağmur, S. Örgel & Ö. Eser (AZMM). **Paratypes**: data as for holotype, 9 ♂, 18 ♀ (AZMM); data as for holotype, 9 ♂, 18 ♀ (GTC); data as for holotype but 1599 m a.s.l., 37°42'41"N, 29°29'32"E, 24 September 2016, leg. E. A. Yağmur & M. Bulut, 1♂, 9♀ (AZMM).

Geographic range. Southwestern Turkey, Denizli Province (Fig. 44).

Etymology. The specific epithet honors Dr. Hakan Durmuş, a Turkish herpetologist and a teacher of the second author.

Diagnosis. A medium-small *Euscorpius* species, total length 26–31 mm. Color of adults is light brown to medium brown-reddish, without dark marbling on chelicerae. The number of trichobothria on the pedipalp manus ventral surface is 4 ($V_{1-3} + Et_1$). Trichobothrium et on fixed finger is located distally to the notch of the fixed finger; est is located proximally or above the notch; and dsb is located proximally to est and the notch. The number of trichobothria on the pedipalp patella ventral surface is usually 7. The number of trichobothria on pedipalp patella external surface usually is: $eb = 4$, $eb_a = 4$, $esb = 2$, $em = 3$, $est = 4$, $et = 5$ and 6 (5). Trichobothrium i of the femur is slightly distal or same level of d . The pectinal teeth number in males is usually 8, and in females usually 6 and 7. Dorsal patellar spur

barely developed. Femur usually shorter than patella (L_{fem}/L_{pat} ratio on average is 0.93). Carapace can be both slightly longer than wide and slightly wider than long. Average ratio $L_{met}/W_{met} > 1.49$ (1.51–1.75 with a mean of 1.63). Dorsal metasomal carinae granulated. Ventrolateral and ventromedian carinae on segment V well formed and serrulated.

Trichobothrial and pectinal teeth count variation

The variation observed in 65 examined specimens (20 ♂ and 45 ♀) is given below.

Pectinal teeth in males (n=20): 8/8 (19), 8/9 (1); in total, 8 in 97.5 % (39) and 9 in 2.5 % (1); mean = 8.02, SD = 0.16.

Pectinal teeth in females (n=45): 6/6 (19), 6/7 (6), 7/6 (5), 7/7 (15); in total, 6 in 54.44 % (49) and 7 in 45.56 % (41); mean = 6.45, SD = 0.50.

Pedipalp patella trichobothria Pv (n=65): 4/6 (1), 6/6 (2), 6/7 (2), 7/7 (57), 7/8 (1), 8/8 (2); in total, 4 in 0.77 % (1), 6 in 5.38 % (7), 7 in 89.99 % (117) and 8 in 3.85 % (5); mean = 6.98, SD = 0.30.

Pedipalp patella trichobothria Pe (n=65): $et = 5/4$ (1), 5/5 (36), 3/6 (1), 5/6 (7), 6/5 (3), 6/6 (17); in total, 3 in 0.77 % (1), 4 in 0.77 % (1), 5 in 63.85 % (83) and 6 in 34.61 % (45); mean = 5.35, SD = 0.48; $est = 4/3$ (1), 4/4 (64); $em = 1/3$ (1), 3/2 (1), 3/3 (63); $esb = 2/2$ (65); $eb_a = 3/4$ (1), 4/3 (1), 4/4 (63); $eb = 4/4$ (64), 4/5 (1).

Description holotype

Coloration. Entire body color light brownish with carapace and pedipalps darker, light brownish/reddish; the carapace has a slightly darker marbling; sternites and pectines and genital operculum very light brownish/ivory; chelicerae, telson and legs yellowish without marbling; all pedipalp carinae darker, dark reddish to blackish colored.

Carapace. A more or less homogeneous size granulation is present; anterior edge straight; posterior lateral, posterior median, and anterior median furrows are present; two pairs of lateral eyes, and a pair of median eyes, situated distally of the middle; distance from centre of median eyes to anterior margin is 42.13 % of carapace length.

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

Metasoma. Dorsal carinae on segments I–IV granulated; ventrolateral carinae on segment I absent, on segment II obsolete and smooth, on segments III obsolete and almost smooth, on segment IV granulated, on segment V well marked and serrulated; ventromedian carinae absent on segment I–IV, on segment V granulated; ventral intercarinal spaces smooth or almost



Figures 23–24: *Euscorpium hakani* sp. n., male, dorsal and ventral views.

25



26



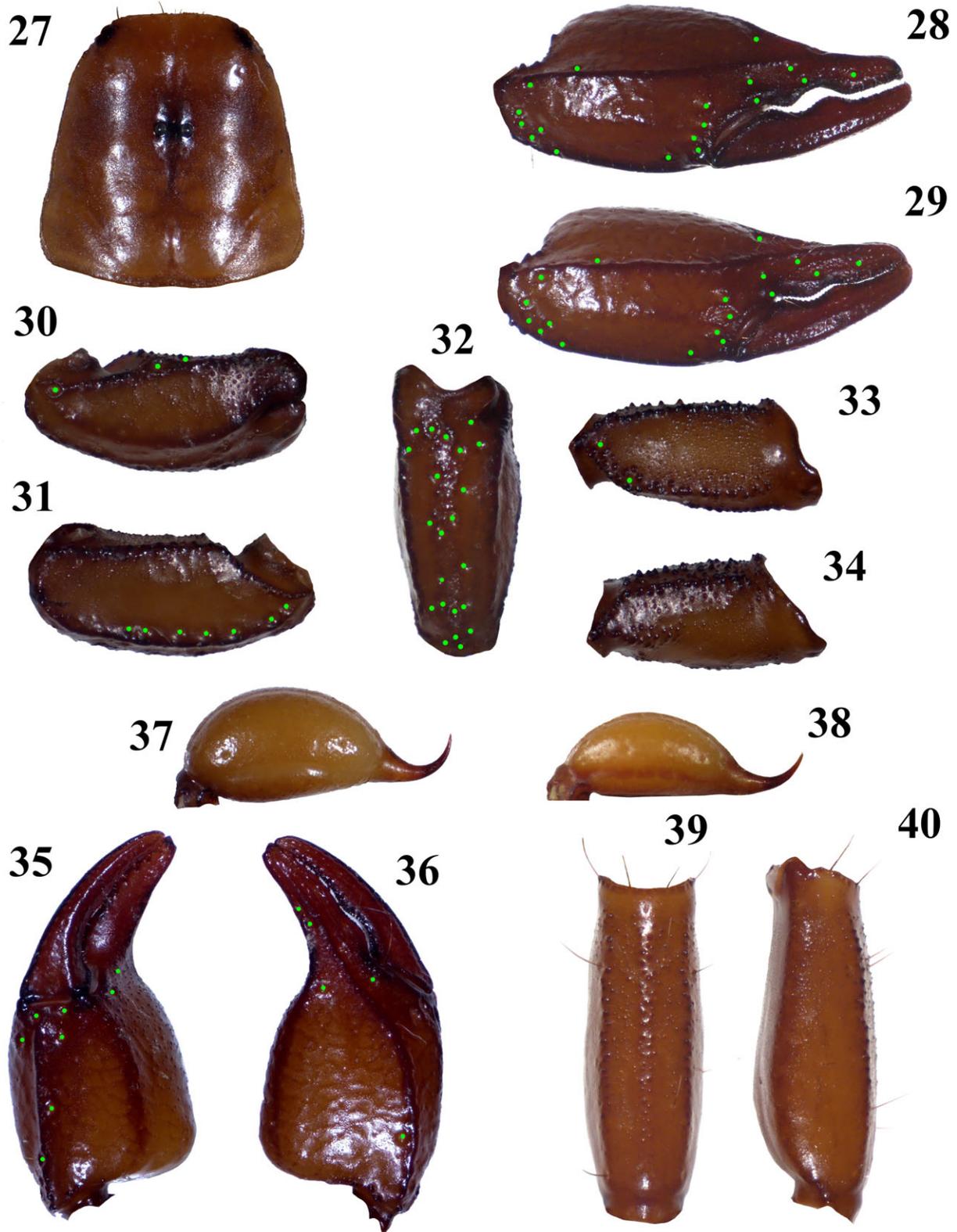
Figures 25–26: *Euscorpius hakani* sp. n., female, dorsal and ventral views.

smooth on surfaces of segments I–III, with a fine granulation on segment IV, granulated with several small granules a few bigger on segment V, finely granulated on lateral and dorsal surfaces.

Telson. Vesicle finely granulated, with ventral setae of different size, especially near the vesicle/aculeus juncture.

Pectines. Teeth number 8/8; middle lamellae number 5/5; 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; a few microsetae are present.



Figures 27–40: *Euscorpium hakani* sp. n. 27. Carapace. 28. External view of chela of adult male. 29. External view of chela of adult female. 30. Dorsal view of pedipalp patella. 31. Ventral view of pedipalp patella. 32. External view of pedipalp patella. 33. Dorsal view of pedipalp femur. 34. Ventral view of pedipalp femur. 35. Ventral view of chela. 36. Dorsal view of chela. 37. Telson of adult male. 38. Telson of adult female. 39. Ventral view of the metasomal segment V. 40. Lateral view of the metasomal segment V.



Figures 41–42: Live specimens of *Euscorpius hakani* sp. n. in natural habitat 41. Male. 42. Female.



Figure 43: Habitat where the specimens of *E. hakani* sp. n. were collected.

Sternum. Pentagonal shape, type 2; slightly more wide than long, with a deep posterior emargination.

Pedipalps. Coxa and trochanter with tuberculated carinae. Femur: dorsal internal, ventral internal and dorsal external carinae granulated and tuberculated; irregular ventral external carinae formed by tubercles just in the 1/3 proximal area of the femur length; external median carinae formed by serrulated tubercles in distal 1/2; anterior median carinae adjacent to ventral internal carinae, formed by about eleven conical and spaced tubercles of variable size; intercarinal spaces granulated, with bigger granule on dorsal surface near the carinae. Patella: dorsal and ventral internal carinae granulated, the latter slightly serrulated; dorsal external carinae smooth, dark and well formed almost in all its long, it becomes thinner and less dark towards the proximal part up until reaching the clear base color; ventral external carinae from crenulated with barely visible little pronounced tubercle to rough; intercarinal surfaces finely granulated, especially near the carinae. Dorsal patellar spur barely developed. Chelal carina D_1 is distinct, strong, dark and smooth; D_4 is rounded, rough and little

marked; V_1 is distinct, strong, dark and smooth with a few tubercles proximally, following an oblique direction toward the internal of trichobothrium Et_1 ; V_3 is rounded, rough and little marked; external carina with little marked granules and rough; intercarinal tegument with fine granules positioned so as to form a reticulation; the fixed finger with notch and movable finger with lobe well formed.

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 4–6 denticles at level of the OD , in proximal position some MD denticles are overlap forming two lines; fixed finger has 6/6 OD , 10/10 ID ; movable finger has 7/7 OD , 13/14 ID .

Trichobothria. Chela: trichobothria on the pedipalp manus ventral surface $V = 3/3 (V_{1-3}) + Et_1 = 1/1$; trichobothrium V_4 situated on the carina V_1 or almost on it; trichobothrium on fixed finger est situated in proximal half of the notch of the fixed finger. Patella: $Pv = 7/7$; $et = 5/5$, $est = 4/4$, $em = 3/3$, $esb = 2/2$, $eba = 4/4$, $eb = 4/4$. Femur: trichobothrium d is barely proximal to i ,

		<i>E. aladaglarensis</i> sp. n.		<i>E. hakani</i> sp. n.	
		Holotype ♂	Paratype ♀	Holotype ♂	Paratype ♀
Total	Length	31.62	28.67	30.67	29.93
Carapace	Length	4.50	4.32	3.94	4.08
	Post. width	4.38	4.26	4.07	3.87
Metasoma	Length	12.60	10.49	12.93	11.72
Segment I	Length	1.62	1.38	1.68	1.58
	Width	1.62	1.50	1.62	1.73
Segment II	Length	1.98	1.62	2.04	1.86
	Width	1.44	1.29	1.50	1.50
Segment III	Length	2.22	1.79	2.28	2.05
	Width	1.41	1.23	1.44	1.44
Segment IV	Length	2.58	2.10	2.70	2.46
	Width	1.32	1.08	1.42	1.37
Segment V	Length	4.20	3.60	4.23	3.78
	Width	1.38	1.20	1.41	1.32
Telson	Length	4.68	3.66	4.02	3.57
Vesicle	Length	3.54	2.46	3.00	2.49
	Width	1.92	1.44	1.68	1.44
	Height	2.01	1.26	1.68	1.28
Aculeus	Length	1.14	1.20	1.70	1.08
Femur	Length	3.72	3.42	3.00	2.91
	Width	1.38	1.32	1.20	1.29
Patella	Length	3.78	3.54	3.24	3.18
	Width	1.44	1.44	1.20	1.38
Chela	Length	7.95	7.26	6.57	6.42
	Width–A	3.18	2.88	2.82	2.70
Movable finger	Length	4.50	3.90	3.84	3.54
Ratios	Lcar/Wcar	1.027	1.014	0.966	1.054
	Lcar/Lfer	1.209	1.263	1.312	1.402
	Lcar/Lpat	1.190	1.220	1.215	1.283
	Lcar/Ltel	0.961	1.180	0.979	1.143
	Lchel/Wchel	2.500	2.521	2.330	2.378
	L/W met.seg I	1.000	0.920	1.037	0.913
	L/W met.seg II	1.375	1.256	1.360	1.240
	L/W met.seg III	1.574	1.458	1.583	1.421
	L/W met.seg IV	1.954	1.944	1.907	1.798
	L/W met.seg V	3.043	3.000	3.000	2.863
	Lmet/Wmet	1.757	1.666	1.751	1.594
	Lmet/Lcar	2.800	2.429	3.285	2.873
	Lfem/Lpat	0.984	0.966	0.926	0.915
Htel/Wves	1.047	0.875	1.000	0.887	

Table 1: Measurements (mm) and morphometric ratios of *E. aladaglarensis* sp. n. and *E. hakani* sp. n.

while trichobothrium *e* is well distal to both *d* and *i*, and situated on dorsal surface barely on dorsal external carina.

Legs. Two pedal spurs present; no tarsal spur; ventral row of the tarsus of the legs pair III with a total of 15/15 spinules. The spinule are of increasing size from proximal to distal, ending with 2 spinule that form like an "Y"; 3 main flanking tarsal setae present. Tubercles present on ventral and dorsal surface of all leg femora, they are more marked and dark ventrally.

Chelicerae. Typical of the genus *Euscorpium*.

Ecological notes

Some of the specimens were collected near the top of Mt. Eşeler. This area is open and grassy. The rest of the specimens were collected under stones in the black pine forest (*Pinus nigra*) (fig. 43). Both of these localities are cool and humid.

Distinction of *E. hakani* sp. n. from the other Turkish *Euscorpium* species

In Turkey, there are sixteen species of the genus *Euscorpium* (not including *E. hakani* sp. n.), all morphologically and/or geographically well distinguishable from *E. hakani* sp. n.

E. hakani sp. n. has the trichobothrial series $V = 3$, which easily distinguishes it from *E. italicus*; the trichobothrial series on the pedipalp patella external surface $em = 3$ that distinguishes it from *E. aladaglarensis* sp. n.; and the trichobothrial series $em = 3 +$ the carina $V1$ that follows an oblique direction toward the inside of the trichobothrium $Et1$, that distinguishes it from the phylogenetically distant species with $em = 4$.

E. hakani sp. n. can be easily distinguishes from the others species with $em = 3$ mainly by the peculiar trichobothrial series $Pv = 7$; indeed all the others species with $em = 3$ have $Pv < 7$, except *E. ciliciensis*, which has the same trichobothrial count of *E. hakani* sp. n. However, the latter can be distinguished from *E. ciliciensis* by (1) the dorsal patellar spur barely developed in *E. hakani* sp. n. versus a dorsal patellar spur well-developed in *E. ciliciensis*; (2) trichobothrium V_4 situated on the carina $V1$ or almost on it in *E. hakani* sp. n. while it is situated on the external surface of the chela not in contact with the carina $V1$ in *E. ciliciensis*; (3) *E. hakani* sp. n. has the metasomal carinae most developed, especially those of the metasomal segment V, which both ventromedian and ventrolateral carinae are well formed and granulated while in *E. ciliciensis* the metasomal segment V can be smooth, almost smooth, or with a few small spaced granule, mostly ventrolaterally; (4) *E. hakani* sp. n. has $Lcar/Lfer > 1.29$ (range 1.30–1.41; mean 1.37 SD 0.14) vs. $Lcar/Lfer < 1.30$ (range 1.11–1.27; mean 1.22 SD 0.06) in *E. ciliciensis*; (5) *E. hakani*

sp. n. has $Lmet/Lcar > 2.76$ (2.77–3.33; mean 3.06 SD 0.25) vs. $Lmet/Lcar < 2.77$ (2.37–3.76; mean 2.62 SD 0.23) in *E. ciliciensis*. In addition, *E. hakani* sp. n. occurs in Denizli Province in southwestern Turkey while *E. ciliciensis* occurs in the eastern part of the Central Taurus Mts.

The species geographically closer to *E. hakani* sp. n. is *E. honazicus*. They have very similar and overlapping morphological proportions. However *E. hakani* sp. n. is on average larger than *E. honazicus*, with an average of 28.42 and a range of 26–31 vs. a mean of 26.11 and a range of 22–29 respectively. In addition, the metasomal carinae have, especially on the ventral surface of the segments IV and V, often the tubercles more pronounced in *E. honazicus*. However with the series $Pv = 7$, *E. hakani* sp. n. is easily distinguishable from *E. honazicus*.

Comments

In the last years our group has been intensively studying the genus *Euscorpium* in Turkey, resulting in a significant increase of the species of this genus in the country. Since 2012, the number of species in Turkey have increased from 2 to 17, including the new species herein described (Tropea & Yağmur, 2015, 2016; Tropea et al., 2012, 2014a, 2015b, 2016a, 2016b; Yağmur & Tropea, 2013, 2015; Yağmur et al., 2013).

These species have been found mostly in relatively restricted mountainous areas with the exception of *E. mingrelicus*, which, at present, has a very extensive distribution when compared to other Turkish species of *Euscorpium*. Indeed, already Tropea et al. (2015b) recommended further studies, especially genetic. This high degree of speciation in mountainous areas, often with restricted distribution areas, is in agreement with other new species of *Euscorpium* described in other countries in recent years (see Tropea et al., 2013, 2014b, 2015a, 2015c).

Our unpublished morphological and molecular data indicate the presence of probable good species from different mountainous areas and that some populations might need to be more thoroughly investigated (Tropea & Yağmur, 2016).

Recently, Fet et al. (2016) presented a phylogeny based on specimens related to subgenus *Alpiscorpium*, collected in Turkey. Independently, our group also is studying different populations on genetic basis, in addition to the morphological, and the high diversification shown from their data is in accordance with our published, and unpublished, morphological and genetic data.

In this paper we describe two new species, *E. hakani* sp. n. and *E. aladaglarensis* sp. n. The latter species was known to us for several years, but we were waiting for additional specimens to get satisfactory statistical sampling and confirmation that the peculiar character combination $et = 6$ and $em = 4$ were fixed. For



Figure 44: Distribution of *Euscorpius aladaglarenensis* sp. n. (red circle) and *E. hakani* sp. n. (blue circle).

this work, we examined 112 pedipalps, in which $et = 6$ was present in 76%, and $em = 4$ in the 97.3%, demonstrating that these characters are hard fixed in this population. The phylogeny of Fet et al. (2016) showed a population from Kayseri Province with the character $em = 4$, which corresponds to *E. aladaglarenensis* sp. n. According to their phylogeny based on COI marker for this population, it was closely related to *E. ciliciensis*, as was expected, showing only the 4% of genetic divergence. This level of divergence is not very high for the COI. However, it is noteworthy that *E. aladaglarenensis* sp. n. also is not highly divergent from *E. eskisehrensensis* (4.4%) and *E. phrygius* (“*Euscorpius* sp. from Ankara” in Fet et al., 2016; see Tropea et al., 2016a for explanations) (4.8 %). Their phylogenetic tree shows that these species are well separated, with the divergence of lineages between the Pliocene and the Pleistocene. The second new species described herein, *E. hakani* sp. n., having the trichobothrial series $Pv = 7$, $et = 5$, and $em = 3$, also presents a peculiar trichobothrial pattern, only shared with *E. ciliciensis* (and some specimens of *E. mingrelicus*; Tropea, unpublished data). However, the morphology, in accordance with the geographical area, suggests that this species is related to other species with the typical series $Pv = 6$, as *E. arikani* and *E. honazicus*. The latter species is geographically the closest, being present on Mt. Honaz but easily distinguishable by the Pv series. Kinzelbach (1975) reports some populations with $Pv = 7$ from the southwestern Turkey, more pre-

cisely from “Acipayam, SSE Denizli”, “Honaz Dagi, E Denizli”, “Egridir”, and “Kokikos bei Kizkale”. These locations are the same as cited by Vachon (1951). He identified them as *E. germanus ciliciensis* in the map, but in the text he stated that they could be a variety of this subspecies, or a new form. It should be noted that Vachon did not list the number of trichobothria of these specimens. In addition, the specimens from Mt. Honaz (*E. honazicus*) have $Pv=6$, as do all the populations in the neighbourhood, except *E. hakani* sp. n. Therefore, a probably explanation for the Kinzelbach's data could be that he erroneously assumed *a priori* that these specimens have $Pv = 7$ since they were identified by Vachon as *E. g. ciliciensis*; therefore actually this is the first time that this population is signalled.

Additional specimens as well as both morphological and genetic studies are needed to better understand the true diversity and relationships of these species, as well of the others of the genus *Euscorpius* in Turkey. Within the frame of a well informed morphological and molecular phylogeny approach, it is very likely that the number of species will increase.

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References

- FET V., M.R. GRAHAM, G. BLAGOEV, A. KARATAŞ & A. KARATAŞ. 2016. DNA barcoding indicates hidden diversity of *Euscorpius* (Scorpiones: Euscorpiidae) in Turkey. *Euscorpius*, 216: 1–12.
- HJELLE, J.T. 1990. Anatomy and morphology. (pp. 9–63). In: Polis G.A. (editor). *The Biology of Scorpions*. Stanford University Press, Stanford, CA, 587 pp.
- KINZELBACH, R. 1975. Die Skorpione der Ägäis: Beiträge zur Systematik, Phylogenie und Biogeographie. *Zoologische Jahrbücher, Abteilung für Systematik*, 102: 12–50.
- SISSOM, W.D. 1990. Systematics, biogeography and paleontology. (pp. 64–160). In: Polis G. A. (editor). *The Biology of Scorpions*. Stanford University Press, Stanford, CA, 587 pp.
- SOLEGLAD, M.E. & V. FET. 2003. The scorpion sternum: structure and phylogeny (Scorpiones: Orthosterni). *Euscorpius*, 5: 1–33.
- SOLEGLAD, M.E. & W.D. SISSOM. 2001. Phylogeny of the family Euscorpiidae Laurie, 1896: a major revision. (pp. 25–112). In: Fet, V. & P.A. Selden (editors). *Scorpions 2001. In memoriam Gary A. Polis*. Burnham Beeches, Bucks, UK: British Arachnological Society.
- STAHNKE, H.L. 1971. Scorpion nomenclature and mensuration. *Entomological News*, 81: 297–316.
- TROPEA G., V. FET, A. PARMAKELIS, P. KOTSAKIOZI & I. STATHI. 2013. A new species of *Euscorpius* Thorell, 1876 from Peloponnese, Greece (Scorpiones: Euscorpiidae). *Euscorpius*, 169: 1–11.
- TROPEA, G., V. FET, A. PARMAKELIS, P. KOTSAKIOZI & I. STATHI. 2014b. Three new species of *Euscorpius* (Scorpiones: Euscorpiidae) from Greece. *Euscorpius*, 190: 1–22.
- TROPEA, G., V. FET, A. PARMAKELIS, P. KOTSAKIOZI & I. STATHI. 2015a. A new species of *Euscorpius* (Scorpiones: Euscorpiidae) from southern Bulgaria. *Arachnologische Mitteilungen*, 49: 10–20.
- TROPEA, G., V. FET, A. PARMAKELIS, P. KOTSAKIOZI & I. STATHI. 2015c. A new species of *Euscorpius* from Bulgaria and Greece (Scorpiones: Euscorpiidae). *Euscorpius*, 207: 1–15.
- TROPEA, G. & E.A. YAĞMUR. 2015. Two new species of *Euscorpius* Thorell, 1876 from Turkey (Scorpiones: Euscorpiidae). *Arachnida*, 4: 13–32.
- TROPEA, G. & E.A. YAĞMUR. 2016. A new species of *Euscorpius* Thorell, 1876 from the Sultan Mountains in western Turkey (Scorpiones: Euscorpiidae). *Arachnida*, 6: 32–43.
- TROPEA, G., E.A. YAĞMUR & V. FET. 2015b. A revision of the Anatolian-Caucasian “*Euscorpius mingrelicus* complex” (Scorpiones: Euscorpiidae). *Euscorpius*, 203: 1–32.
- TROPEA, G., E.A. YAĞMUR, H. KOÇ, F. YEŞILYURT & A. ROSSI. 2012. A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from Turkey. *ZooKeys*, 219: 63–80.
- TROPEA, G., E.A. YAĞMUR & F. YEŞILYURT. 2014a. A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from the Antalya Province, Southern Turkey. *Euscorpius*, 184: 1–13.
- TROPEA, G., E.A. YAĞMUR, L. KARAMPATSOU, A. PARMAKELIS & F. YEŞILYURT. 2016a. A new species of *Euscorpius* Thorell, 1876 from Mount Honaz in Southwestern Turkey (Scorpiones: Euscorpiidae). *Euscorpius*, 222: 1–14.
- TROPEA, G., E.A. YAĞMUR, A. PARMAKELIS & K.B. KUNT. 2016b. Another new species of *Euscorpius* Thorell, 1876 from the Taurus Mountains in Antalya Province, Southern Turkey (Scorpiones: Euscorpiidae). *Euscorpius*, 231: 1–15.
- VACHON, M. 1951. A propos de quelques scorpions de Turquie collectés par M. le Professeur Dr. Curt Kosswig. *Istanbul Üniversitesi Fen Fakültesi Mecmuası (Revue de la Faculté des Sciences de l’Université d’Istanbul)*, 16 (B): 341–344.
- VACHON, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les scorpions. *Bulletin du Muséum National d’Histoire naturelle, Paris*, 140: 859–958.
- YAĞMUR, E.A. & G. TROPEA. 2013. A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from Marmara Region of Turkey. *ZooKeys*, 281: 91–105

- YAĞMUR, E.A. & G. TROPEA. 2015. A new species of *Euscorpius* Thorell, 1876 from southwestern Turkey (Scorpiones: Euscorpiidae). *Arachnida*, 3: 14–26.
- YAĞMUR, E.A., G. TROPEA & F. YEŞİLYURT. 2013. A new species of *Euscorpius* Thorell, 1876 (Scorpiones, Euscorpiidae) from south western Turkey. *ZooKeys*, 348: 29–45.