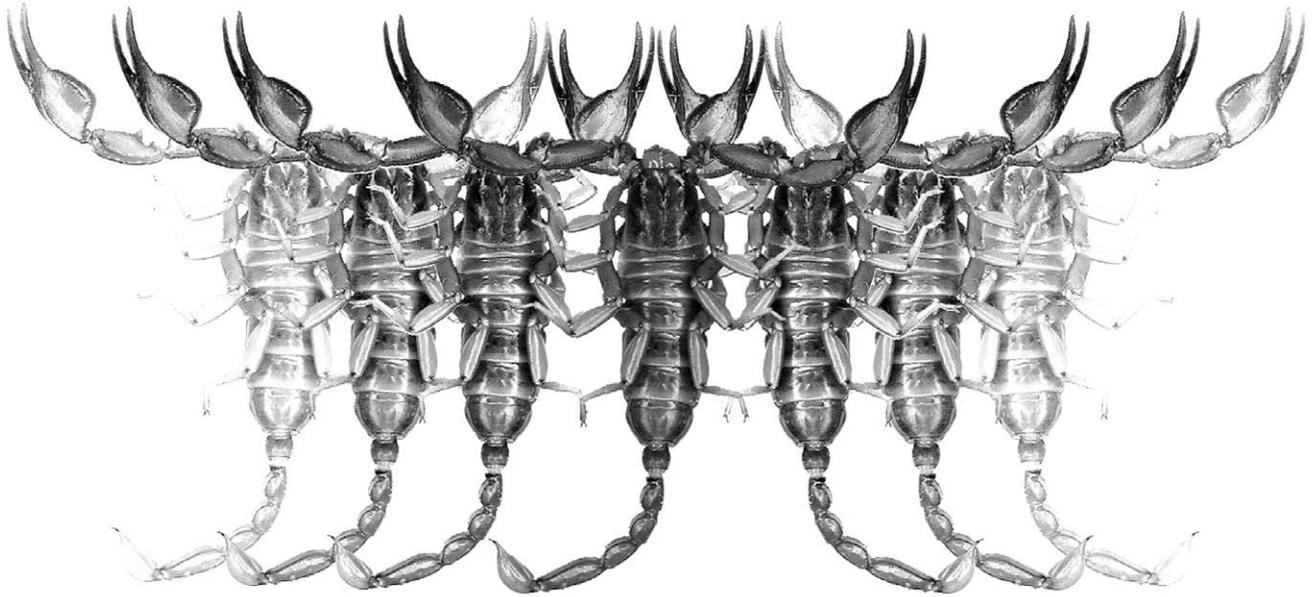


# *Euscorpilus*

Occasional Publications in Scorpiology



**Another New Species of *Euscorpilus* Thorell, 1876 from the  
Taurus Mountains in Antalya Province, Southern Turkey  
(Scorpiones: Euscorpiidae)**

**Gioele Tropea, Ersen Aydın Yağmur, Aristeidis Parmakelis  
& Kadir Boğaç Kunt**

**September 2016 — No. 231**

# *Euscorpius*

## Occasional Publications in Scorpiology

EDITOR: Victor Fet, Marshall University, 'fet@marshall.edu'  
ASSOCIATE EDITOR: Michael E. Soleglad, 'soleglad@znet.com'

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### *Derivatio Nominis*

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

*Euscorpius* is located at: <http://www.science.marshall.edu/fet/Euscorpius>

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In September 2012, ICZN Article 8. *What constitutes published work*, has been amended and allowed for electronic publications, disallowing publication on optical discs. From January 2013, *Euscorpius* discontinued CD-ROM production; only online electronic version (*ISSN 1536-9307*) is published. For further details on the new ICZN amendment, see <http://www.pensoft.net/journals/zookeys/article/3944/>.

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Publication date: 12 September 2016

<http://zoobank.org/urn:lsid:zoobank.org:pub:E8EE40C9-ADE6-416E-81EC-AC3B903203EA>

# Another new species of *Euscorpius* Thorell, 1876 from the Taurus Mountains in Antalya Province, southern Turkey (Scorpiones: Euscorpiidae)

Gioele Tropea<sup>1</sup>, Ersen Aydın Yağmur<sup>2</sup>, Aristeidis Parmakelis<sup>3</sup> & Kadir Boğaç Kunt<sup>4</sup>

<sup>1</sup> Via Gavinana, 2, Rome, Italy: email: gioele.tropea@gmail.com

<sup>2</sup> Celal Bayar University, Alaşehir Vocational School, Manisa, Turkey

<sup>3</sup> Department of Ecology and Taxonomy, Faculty of Biology, National and Kapodistrian University of Athens, Panepistimioupoli Zografou, GR-15784, Athens, Greece

<sup>4</sup> Department of Biology, Faculty of Science, Anadolu University, TR- 26470, Eskisehir, Turkey

<http://zoobank.org/urn:lsid:zoobank.org:pub:E8EE40C9-ADE6-416E-81EC-AC3B903203EA>

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## Summary

A new scorpion species, *Euscorpius alanyaensis* sp. n., is described based on specimens collected from the Taurus Mountains in Antalya Province (Alanya District) in southern Turkey. It is a sibling species of the recently described *E. gocmeni* Tropea et al., 2014, and similarly, the new species is also characterized by a high trichobothrial count ( $Pv = 9-11$ ,  $et = 7$ ,  $em = 4$ , and  $eb = 4$ ), a high pectinal teeth count ( $Dp = 9-11$  in males, 8 in females), medium-small size, and light to medium brown-reddish colour. In addition, for the first time a phylogenetic analysis (concatenated sequences of *16S rDNA* and *COI*) is performed to reconstruct the relationships between *E. gocmeni* Tropea et al., 2014, *E. koci* Tropea et Yağmur, 2015, *E. lycius* Yağmur et al., 2013, *E. avcii* Tropea et al., 2012 from Turkey, and the new species herein described, *E. alanyaensis* sp. n.

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## 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 2,600 m a. s. l. (Tropea et al., 2015a). Taxonomy of this genus is complicated and still unresolved throughout its range. In the last years our group is 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 has increased from two to 14, not including the new species described herein (Tropea & Yağmur, 2015, 2016; Tropea et al., 2012, 2014, 2015b, 2016; Yağmur & Tropea, 2013, 2015; Yağmur et al., 2013). In addition, recently Fet et al. (2016) published a phylogeny on populations related to the sub-genus *Alpiscorpius* Gantenbein et al., 1999 in Turkey. In this paper, as a part of an ongoing study on the populations of the genus *Euscorpius* in Turkey, we describe a new species, *Euscorpius alanyaensis* sp. n., based on morphological and molecular evidence, increasing to 15 the *Euscorpius* species currently recognized from Turkey.

## Materials and Methods

The trichobothrial notations follow Vachon (1974). The morphological measurements are given in millimetres (mm) following Tropea et al. (2014). The morphological nomenclature follows Stahnke (1971), Hjelle (1990) and Sissom (1990); terminology for the chela carinae and denticle configuration follows Soleglad & Sissom (2001); and sternum terminology follows Soleglad & Fet (2003).

## Sequence Data Generation and Phylogenetic Analyses

For the present study, we extracted total DNA and amplified fragments of the *16S rDNA* and *COI mtDNA* genes for the first time from nine *Euscorpius* specimens belonging to four different species (Table 2). DNA extraction, PCR amplifications and sequencing was performed as described in Parmakelis et al. (2013). Sequence editing and alignment was performed using Codon Code Aligner v.2.06. The genetic distances were computed using the Kimura 2-parameter method (Kimura, 1980) as implemented in MEGA6 (Tamura et

al., 2013). Genetic distances are expressed as the number of base substitutions per site. Standard error estimate(s) are shown above the diagonal and were obtained by a bootstrap procedure (1000 replicates). All ambiguous positions were removed for each sequence pair. There were a total of 441 positions in the final dataset for *16S rDNA* fragment and 590 for *COI*. Out of these, 49 and 140 were parsimony informative in the *16S rDNA* and the *COI* fragment, respectively. For the phylogenetic analyses, we retrieved from GenBank the *16S rDNA* and *COI* sequences of several *Euscorpius* species (Table 2). These species, based on morphological and/or distributional data, are the ones that are more closely related to the species investigated herein. The species *E. flavicaudis* was used as an outgroup in the analysis.

The phylogenetic analysis was performed under a Bayesian Inference framework (BI) using MrBayes v.3.2.2 (Ronquist et al., 2012). The Bayesian Information Criterion (Schwarz, 1978) as implemented in PartitionFinder (Lanfear et al., 2012), was used to choose both the best-fit model of nucleotide substitution for each gene fragment and the best partition scheme to perform the analyses. The models selected were the TN93+G and TN93+I+G, for the *16S rDNA* and *COI*, respectively. The sequence data were partitioned according to gene and each parameter was estimated independently in each partition. In MrBayes, two independent runs with five chains each were run simultaneously. The chain length was set to  $10 \times 10^6$ . Convergence was assumed when the average standard deviation of split frequencies was below 0.01. A tree was sampled every 500 generations and, consequently, the summaries of the BI relied on  $4 \times 10^4$  samples (sum of two runs). From each run 15,001 samples were used, while 4,999 were discarded as burn-in phase (25% burn-in). From the remaining 30,002 trees (sum of two runs), a 50% majority rule consensus tree was constructed for each dataset analysis. Support of the nodes was assessed with the posterior probabilities of reconstructed clades.

### Material examined

A total of 20 specimens of *Euscorpius alanyaensis* sp. n. have been examined (see *Type Material*). The specimens and species listed below have been examined for comparison:

***E. avcii***: Turkey, Aydın Province, Kuşadası District, Dilek Peninsula, near Davutlar Town, Dilek Peninsula National Park, Canyon, 7 October 2005, leg. H. Koç, 1 ♂ (MTAS; Holotype); same data, 1 ♂, 5 ♀, 7 October 2005, leg. H. Koç (MZUF; paratypes); same data, 1 ♂, 2 ♀ (GTC; paratypes).

***E. koci***: 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. Kuru, 8 ♂, 20 ♀ (GTC; paratypes).

***E. lycius***: Turkey, Muğla Province, Fethiye District, Faralya Village, 36°29'37"N, 29°08'07"E, 349 m, 30 May 2012, leg. F. Yeşilyurt & E. A. Yağmur, 1 ♂ (AZM; holotype); same data, 3 ♀, 4 ♂, leg. F. Yeşilyurt & E. A. Yağmur (KUAM; paratypes); same data, 2 ♀, 2 ♂ (GTC; paratypes).

***E. rahsenae***: Turkey, Bursa Province, Mudanya District, Tirilye Village, 40°23'08.9"N, 28°48'20.9"E, 39 m, Red Pine Forest, 6 July 2012, leg. R.S. Kaya & H. Kuru, 1 ♂ (AZM; holotype); Bursa Province, Nilüfer District, Beşevler Neighborhood, 40°11'47"N, 28°57'58"E, 153 m, 5 May 2005, leg. R.S. Kaya, 1 ♀ (AZM; paratype); Bursa Province, Mudanya District, Tirilye Village, 40°23'08.9"N, 28°48'20.9"E, 39 m, 17 June 2012, leg. E.A. Yağmur & R.S. Kaya, 1 ♂, 1 ♀ (GTC; paratypes).

***E. gocmeni***: Turkey, Antalya Province, Akseki District, Murtiçi Village, 36°51'52.8"N, 31°45'02.9"E, 495 m, 1 September 2011, leg. F. Yeşilyurt & E. A. Yağmur, 1 ♂ (AZM; holotype); same data, 1 ♂ (GTC; paratype); same locality, 3 August 2013, leg. E. A. Yağmur & E. Tezcan, 2 ♂ (AZM; paratypes); same data, 2 ♂, 1 ♀ (GTC; paratypes).

### Abbreviations

Abbreviations: *V*: trichobothria on pedipalp chela manus ventral surface; *Pv*: trichobothria on patella ventral surface; *Pe*: trichobothria on pedipalp patella external surface; *et*: external terminal; *est*: external subterminal; *em*: external medium; *esb*: external supra-basal; *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-A*: chela width; *Wchel-B*: width of the chela with vertical finger alignment; *Lcar*: carapace length; *Wcar*: carapace width; *Lfem*: femur length; *Lpat*: patella length; *Lmet*: metasoma length; *met.seg*: metasomal segment; *CarA%*: average ratio of distances from centre of median eyes to anterior margins of the carapace; *DPS*: dorsal patellar spur; *DD*: distal denticle; *MD*: median denticles; *OD*: outer denticles; *ID*: inner denticles; *IAD*: inner accessory denticles.

AZM: Zoology Museum of Alaşehir Vocational School, Celal Bayar University, Manisa, Turkey; GTC: private collection of Gioele Tropea, Rome, Italy; KUAM: Arachnological Museum of Kırıkkale University, Kırıkkale, Turkey; MSNB: Museo Civico di Scienze Naturali "E. Caffi", Bergamo, Italy; MTAS: Museum of the Turkish Arachnological Society, Ankara, Turkey; MZUR: Museo di Zoologia "Charles Darwin" dell'Università di Roma "La Sapienza", Rome, Italy; ZMSU: Zoology Museum of Sinop University, Sinop, Turkey.

1



2



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

3



4



Figures 3–4: *Euscorpium alanyaensis* sp. n., female, dorsal and ventral views.

## Systematics

### Family Euscorpiidae Laurie, 1896 Genus *Euscorpius* Thorell, 1876 Subgenus Incertus

*Euscorpius alanyaensis* Tropea, Yağmur, Parmakelis et Kunt sp. n.

(Figs. 1–18, 20, 21, Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:9A6F644A-622C-446F-AB7B-DC3552ACD1AF>

**Type material.** *Holotype*: ♂, Turkey, Antalya Province, Alanya District, Taşatan Plateau, 36°39'56.3"N, 32°08'05.3"E, 754 m, 14 October 2013, leg. K.B. Kunt & M. Elverici (AZM).

*Paratypes*: same data as holotype, 3 ♂, 4 ♀ (AZM); same data as holotype, 3 ♂, 3 ♀, (GTC), same data as holotype but collected 05 April 2014, 1 ♂, 3 ♀ (GTC); Turkey, Antalya Province, Alanya District, Taşatan Plateau, 09 June 2009, leg. K.B. Kunt, 1 ♂, 2 ♀ (AZM);

**Geographic distribution:** Southern Turkey: Antalya Province (see map in Fig. 19).

**Etymology:** The specific epithet refers to the collection locality of the new species.

**Diagnosis:** A small *Euscorpius* species, total length 23–26 mm (average 24 mm). Colour very light brownish-ivory to brownish-reddish with darker chelae and carapace, without marbling. The mesosoma may be darker, greyish, due to the translucent cuticle. Number of trichobothria on pedipalp manus ventral surface is 4 (3  $V$  + 1  $Et_1$ ). 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 the notch. Number of trichobothria on the pedipalp patella ventral surface (*Pv*) is from 9 to 11. Number of trichobothria on pedipalp patella external surface usually is *eb* = 4, *eb<sub>a</sub>* = 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 6 to 7. Pectinal teeth count (*Dp*) is from 10 to 11 in males and usually 8 in females. Chela with a notch on fixed finger and lobe on movable finger in males, obsolete in females. Average *Lchel/Wchel* ratio = 2.774 in males and 2.939 in females. Dorsal patellar spur well developed. Femur longer than patella; average *Lfem/Lpat* ratio = 1.034. Fine granulation on most surfaces, with larger, marked and darker granules along the anterior lateral area behind the lateral eyes and the posterior lateral furrow in males, little present in females. Carapace usually longer than wide but may be as long as wide, or slightly wider than long in females; average ratio *Lcar/Wcar* = 1.029 in males and 1.002 in females; average *CarA%* = 42.11 % of the carapace

length. Average ratio of *Lmet/Lcar* = 2.357 in males and 2.139 in females.

#### **Trichobothrial and pectinal teeth count variation:**

Variation observed in 20 studied specimens (9 males, 11 females) is given below.

*Pectinal teeth, males* (n = 9): 10/? (1), 10/10 (2), 10/11 (3), 11/11 (3); in total, 10 in 47.05 % and 11 in 52.94 %; mean = 10.52, SD = 0.5144

*Pectinal teeth, females* (n = 11): 8/7 (2), 8/8 (6), 8/9 (1), 9/9 (1), 10/10 (1); in total, 7 in 9.09 %, 8 in 68.18 %, 9 in 13.63 %, 10 in 9.09 %; mean = 8.22, SD = 0.7516.

*Pedipalp patella, ventral trichobothria Pv* (n = 20): 9/9 (1), 9/10 (4), 10/9 (1), 10/10 (10), 10/11 (2), 11/10 (1), 10/12 (1); in total, 9 in 22.50 %, 10 in 72.50 %, 11 in 7.50 % and 12 in 2.50 %; mean = 9.95, SD = 0.5970.

*Pedipalp patella, external trichobothria Pe* (n = 20): *et* = 6/6 (1), 6/7 (5), 7/6 (2), 7/7 (10), 8/7 (2); in total, 6 in 22.50 %, 7 in 72.50 %, 8 in 5.00 %; mean = 6.82, SD = 0.5006; *est* = 4/4 (20); *em* = 4/4 (20); *esb* = 2/2 (20); *eb<sub>a</sub>* = 4/4 (20); *eb* = 4/4 (20).

#### **Description of the male holotype (the description of the legs is based on a paratype)**

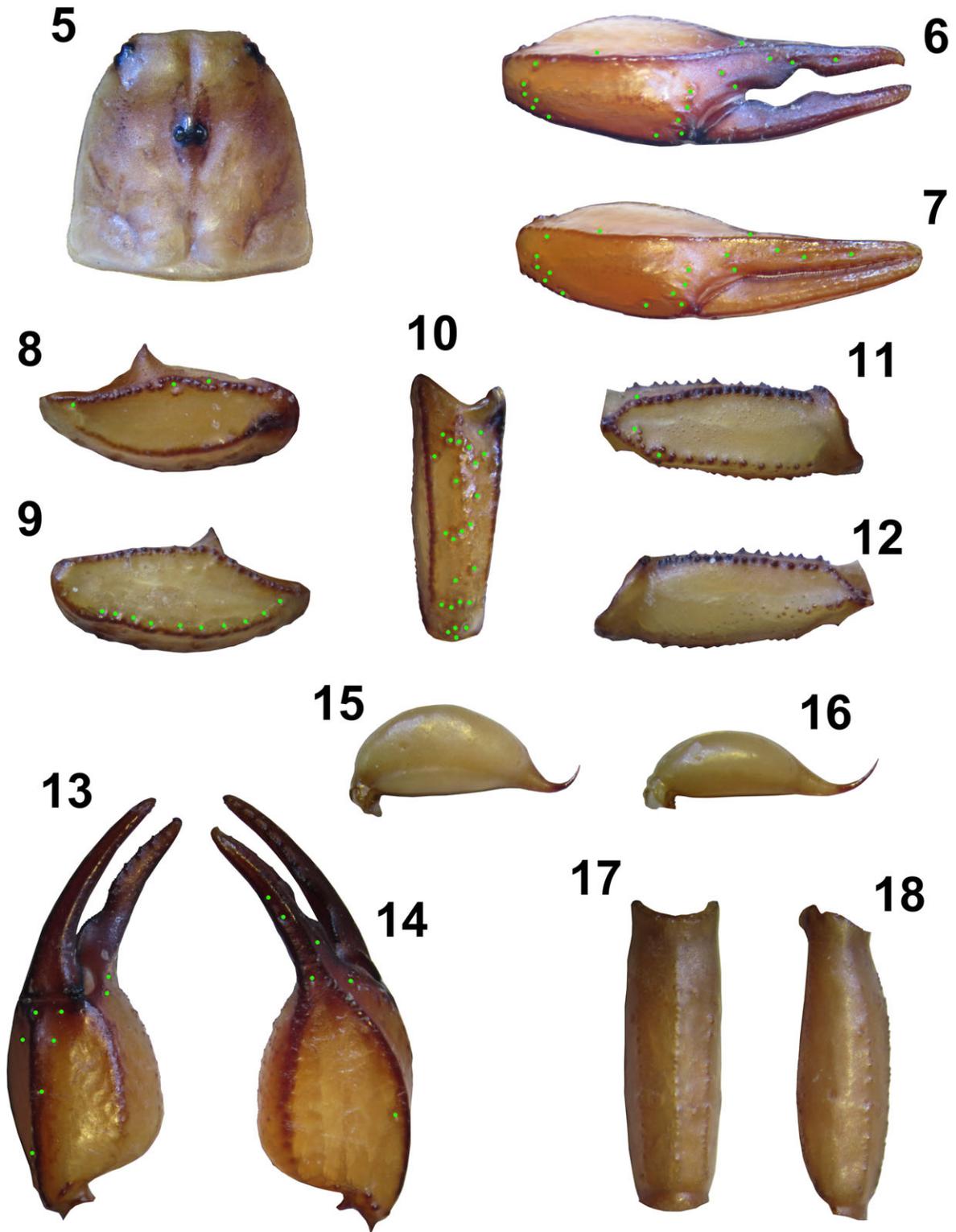
**Coloration:** General colour light brownish to brownish-reddish with darker chelae and carapace, without marbling; sternites brownish, pectines and genital operculum whitish/light brownish; chelicerae very light brownish/yellowish without marbling; telson yellowish with dark reddish aculeus tip.

**Carapace:** Fine granulation on most surfaces, with larger and darker granules along the anterior lateral area behind the lateral eyes and the posterior lateral furrow; anterior edge granulate laterally; posterior lateral, posterior median end anterior median furrows present; two pairs of lateral eyes (anterior eye is visibly larger), and a pair of median eyes, situated distally of the mid-point; length from centre of median eyes to anterior margin is 42.52 % of the carapace length.

**Mesosoma:** Tergites very finely granulated; sternites glossy and finely punctuated; small spiracles inclined to about 45° downward towards outside; area of overlap between sternites paler.

**Metasoma:** Dorsal carinae on segments I–IV with low, spaced granules, on distal area a bit more marked; ventrolateral carinae absent or obsolete on segments I–IV, with small, spaced granules on segment V; ventromedian carina absent or obsolete on segments I–IV, with small, spaced granules on segment V; intercarinal spaces mostly smooth, but the dorsal surface is very finely granulated.

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



**Figures 5–18:** *Euscorpium alanyaensis* 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 femur. 11. Dorsal view of pedipalp femur. 12. Ventral view of pedipalp femur. 13. Ventral view of chela. 14. Dorsal view of chela. 15. Telson of adult male. 16. Telson of adult female. 17. Ventral view of the metasomal segment V. 18. Latero-ventral view of the metasomal segment V.

		<i>Holotype</i> ♂	<i>Paratype</i> ♀
<b>Total</b>	<b>Length</b>	23.54	23.75
<b>Carapace</b>	<b>Length</b>	38.1	4.02
	<b>Post. width</b>	3.72	3.91
<b>Metasoma</b>	<b>Length</b>	8.75	8.75
<b>Segment I</b>	<b>Length</b>	1.14	1.08
	<b>Width</b>	1.17	1.20
<b>Segment II</b>	<b>Length</b>	1.38	1.37
	<b>Width</b>	1.08	1.08
<b>Segment III</b>	<b>Length</b>	1.50	1.50
	<b>Width</b>	1.02	1.02
<b>Segment IV</b>	<b>Length</b>	1.79	1.80
	<b>Width</b>	0.96	0.96
<b>Segment V</b>	<b>Length</b>	2.94	3.00
	<b>Width</b>	1.02	0.96
<b>Telson</b>	<b>Length</b>	3.18	3.47
<b>Vesicle</b>	<b>Length</b>	2.22	2.04
	<b>Width</b>	1.26	1.05
	<b>Height</b>	1.14	0.90
<b>Aculeus</b>	<b>Length</b>	0.96	1.08
<b>Femur</b>	<b>Length</b>	3.30	3.54
	<b>Width</b>	1.14	1.29
<b>Patella</b>	<b>Length</b>	3.18	3.36
	<b>Width</b>	1.26	1.32
<b>Chela</b>	<b>Length</b>	6.60	6.90
	<b>Width-A</b>	2.34	2.40
<b>Movable finger</b>	<b>Length</b>	3.72	3.84
<b>Ratio</b>	<i>CarA (%)</i>	42.52	43.28
	<i>Lcar/Wcar</i>	1.024	1.029
	<i>Lcar/Lfer</i>	1.154	1.136
	<i>Lcar/Ltel</i>	1.198	1.288
	<i>Lchel/Wchel</i>	2.820	2.875
	<i>L/W met.seg I</i>	0.974	0.900
	<i>L/W met.seg II</i>	1.277	1.266
	<i>L/W met.seg III</i>	1.470	1.470
	<i>L/W met.seg IV</i>	1.862	1.875
	<i>L/W met.seg V</i>	2.882	3.125
	<i>Lmet/Wmet</i>	1.666	1.676
	<i>Lmet/Lcar</i>	2.296	2.176
<i>Lfem/Lpat</i>	1.038	1.054	

**Table 1:** Measurements (mm) and morphometric ratios of holotype ♂ and paratype ♀ of *E. alanyaensis* sp. n.

**Pectines:** Teeth count 10/10; 7/6 middle lamellae; several microsetae on proximal area of teeth, marginal lamellae, middle lamellae, and fulcra.

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

**Sternum:** Pentagonal shape, type 2; similar length and width, with a deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculate carinae. Femur: dorsal internal carinae tuberculate and

dark; dorsal external carinae formed by tubercles slightly spaced; external median carinae serrulate; ventral internal carinae tuberculate; ventral external carinae formed by spaced tubercles, well formed only in the proximal 1/3–1/2; anterior median formed by marked conical tubercles varying in size; dorsal intercarinal spaces granulated with granules of varying size; ventral intercarinal spaces not uniformly granulated, with larger granules near the ventral carinae. Patella: dorsal internal carinae tuberculate; dorsal external carinae rough to slightly crenulate; ventral external carinae crenulated;



**Figure 19:** Distribution of *Euscorpium alanyaensis* sp. n. (red circle), *E. gocmeni* (yellow), *E. koci* (green) and *E. lycius* (light blue).

ventral internal carinae tuberculate to serrulate; dorsal intercarinal surface with small scattered granules; ventral intercarinal surface smooth to rough. Dorsal patellar spur well-developed. Chela: chela with a notch on fixed finger and lobe on movable finger not particularly marked; Chelal carina  $D1$  is distinct, strong, dark and from smooth to rough;  $D4$  is rounded and rough;  $V1$  is distinct, strong, dark and smooth;  $V3$  rounded, dark and lightly and finely granulated; external carina granulated, present on distal 1/2; intercarinal tegument rough to finely granulated, just internal surface is well granulated with a scattering of variable-sized granules. Typical *Euscorpium* chela finger dentition.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface is 4/4 ( $V_{1-3} + Et_1$ ); trichobothrium *et* on fixed finger is located distally to the notch of the fixed finger; *est* is located above the notch, slightly moved in distal area; and *dsb* is located proximally to the notch. Patella: ventral (*Pv*): 10/10; patella external (*Pe*): *et* = 7/7, *est* = 4/4, *em* = 4/4, *esb* = 2/2, *eba* = 4/4, *eb* = 4/4. Femur: trichobothrium *d* is at the same level or slightly proximal to *i*, while trichobothrium *e* is distal to both *d* and *i*; it is situated on dorsal external carina but is shifted toward its dorsal surface.

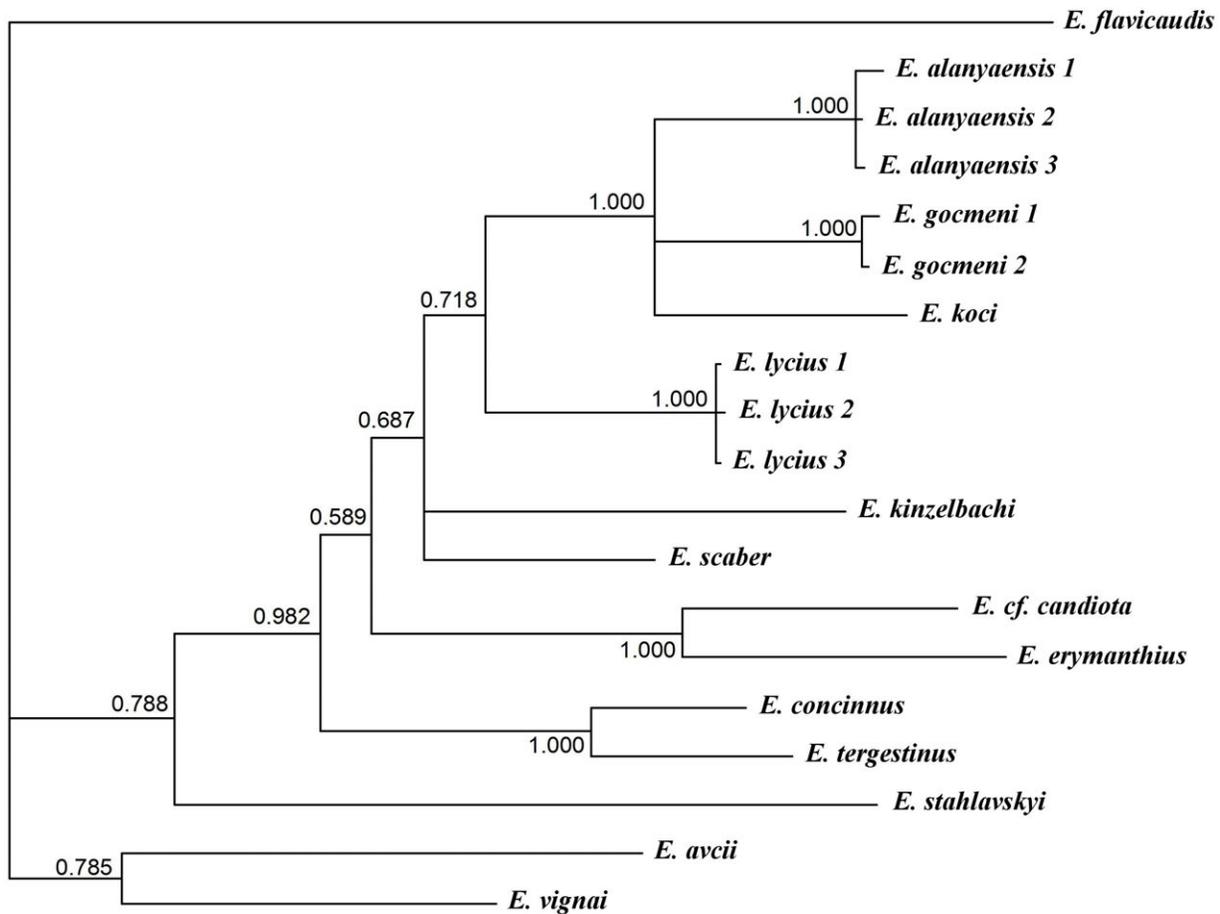
**Legs:** Legs with two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 11/11 spinules of increasing size from proximal to distal, ending with a pair of spinules; 3 flanking pairs of tarsal setae adjacent

to the ventral spinules row. Granulation well evident on dorsal and ventral surfaces of leg femora, mostly marked and dark ventrally.

**Chelicerae:** Smooth, without marbling, with slight darker apical portion of denticles. Movable finger: the dorsal distal denticle is much smaller than the ventral distal denticle; ventral edge is smooth with brush-like setae on the inner part; dorsal edge has five denticles: one large distal, one medium and one small subdistal, one large median and a small basal. Fixed finger with four denticles: one distal, one subdistal, one median and one basal, the last two in a fork arrangement; the internal surface has brush-like setae.

## Comparisons

In Turkey, fourteen species of the genus *Euscorpium* (not including the new species) have been recorded. Of these, *E. (Polytrichobothrius) italicus* is easily recognizable by having the trichobothrial number on the pedipalp manus ventral surface (*V*) higher than 5; and the species relative to the subgenus *Alpiscorpium* can be identified by the trichobothrial series *em* = 3 on the pedipalp patella external surface. The remaining five species, *E. avcii*, *E. koci*, *E. gocmeni*, *E. lycius* and *E. rahsenae*, are similar to the forms of the subgenus *Euscorpium*, with the trichobothrial number on the pedipalp manus ventral surface 4 ( $V_{1-3} + Et_1$ ) and the



**Figure 20:** Phylogeny based on concatenated sequences of *16S rDNA* and *COI*.

trichobothrial series on the pedipalp patella external surface  $em = 4$ . However, the diagnostic characters of the subgenus *Euscorpius* are currently obsolete, as this traditional subgenus appears to be paraphyletic (Parmakelis et al., 2013; Tropea, 2013). Therefore, the five above mentioned Turkish species, as well as *E. alanyaensis* sp. n., are not assigned to any subgenus at present.

The new species, *E. alanyaensis* sp. n., can be mainly distinguished from *E. avcii*, *E. koci*, *E. rahsenae* and *E. lycius* by: **(1)** higher trichobothrial number as follows:  $Pv = 9-10$  and  $et = 6-7$  in *E. alanyaensis* sp. n. vs.  $Pv = 7$  and  $et = 5-6$  in *E. avcii*,  $Pv = 8-9$  and  $et = 6-5$  in *E. koci*,  $Pv = 8$  and  $et = 6$  in *E. rahsenae*, and  $Pv = 9$  and  $et = 6-7$  in *E. lycius*; **(2)** higher  $Dp$  as follows: 10–11 in males and 8 in females of *E. alanyaensis* sp. n. vs. 8 in males and 7 in females of *E. avcii*, 9–10 in males and 7–8 in females of *E. koci*, 9 in males and 7 in females of *E. rahsenae*, and 8–9 in males and 7 in females of *E. lycius*; **(3)** *E. alanyaensis* sp. n. has a  $CarA-CarP$  average ratio of 42.11% vs. 39.20% in *E. avcii*, 40.30% in *E. lycius*, while *E. rahsenae* has a ratio similar to new species, 42.47%.

It is more difficult to distinguish *E. alanyaensis* sp. n. from *E. gocmeni*, a sibling species also present in the province of Antalya. *E. alanyaensis* sp. n. can be mainly distinguished from *E. gocmeni* by: **(1)** lower trichobothrial number as follows:  $Pv = 9-10$  and  $et = 6-7$  in *E. alanyaensis* sp. n. vs.  $Pv = 11-12$  and  $et = 7-8$  in *E. gocmeni*; **(2)** lower  $Dp$  number as follows: 10–11 in males and 8 in females of *E. alanyaensis* sp. n. vs. 10–12 in males and 8–9 in females of *E. gocmeni*; **(3)** the average ratio of  $Lchel/Wchel$  is 2.774 in males and 2.939 in females of *E. alanyaensis* sp. n. vs. 2.521 in males and 2.745 in females of *E. gocmeni*; **(4)** the average ratio of  $Lmet/Lcar$  is 2.357 in males of *E. alanyaensis* sp. n. vs. 2.555 in males of *E. gocmeni*; **(5)** the males of *E. alanyaensis* sp. n. have the carapace with larger, marked and darker granules along the anterior lateral area behind the lateral eyes and the posterior lateral furrow in males, whereas *E. gocmeni* has just a fine granulation on most surfaces, with a few slightly larger granules only along the anterior lateral area behind the lateral eyes.

Species	Locality	Accession number and references	
		16S rDNA	COI
<i>E. alanyaensis</i> sp.n. 1	Turkey, Antalya, Taşatan Plateau	KX807074	KX807081
<i>E. alanyaensis</i> sp.n. 2	Turkey, Antalya, Taşatan Plateau	KX807075	KX807082
<i>E. alanyaensis</i> sp.n. 3	Turkey, Antalya, Taşatan Plateau	KX807076	KX807083
<i>E. avcii</i>	Turkey, Dilek Peninsula	KF030937 (Parmakelis et al., 2013a)	KF030935 (Parmakelis et al., 2013a)
<i>E. cf. candiota</i>	Greece, Crete Island, Dionysades, Prasonisi	KC215594 (Parmakelis et al., 2013b)	KC215677 (Parmakelis et al., 2013b)
<i>E. concinnus</i>	Italy, Elba Island, Procchio	KC215581 (Parmakelis et al., 2013b)	KC215664 (Parmakelis et al., 2013b)
<i>E. erymanthius</i>	Greece, Peloponnese, Kalentzi Mt., 1200m	KC215620 (Parmakelis et al., 2013b)	KC215704 (Parmakelis et al., 2013b)
<i>E. flavicaudis</i>	Italy, Sardinia, Chiaramonti	KC215632 (Parmakelis et al., 2013b)	KC215716 (Parmakelis et al., 2013b)
<i>E. gocmeni</i> 1	Turkey, Antalya, Murtici Village	KX807077	KX807084
<i>E. gocmeni</i> 2	Turkey, Antalya, Murtici Village	KX807078	KX807085
<i>E. gocmeni</i> 3	Turkey, Antalya, Murtici Village	n/a	KX807086
<i>E. kinzelbachi</i>	Greece, Thessaly, Mt. Olympos	KC215615 (Parmakelis et al., 2013b)	KC215694 (Parmakelis et al., 2013b)
<i>E. koci</i>	Turkey, Mersin, Koramislı Village 4km North	KX807079	KX807087
<i>E. lycius</i> 1	Turkey, Muğla and Antalya Provinces	KX807080	KX807088
<i>E. lycius</i> 2	Turkey, Muğla and Antalya Provinces	n/a	KX807089
<i>E. lycius</i> 3	Turkey, Muğla and Antalya Provinces	n/a	KX807090
<i>E. scaber</i>	Greece, Thasos Island, Skala Sotiros	KC215650 (Parmakelis et al., 2013b)	KC215736 (Parmakelis et al., 2013b)
<i>E. stahlavskyi</i>	Greece, Epiros, Mt. Smolikas	KC215653 (Parmakelis et al., 2013b)	KC215739 (Parmakelis et al., 2013b)
<i>E. tergestinus</i>	Croatia, Rab Island, Jurine, Banjol	KC215656 (Parmakelis et al., 2013b)	KC215742 (Parmakelis et al., 2013b)
<i>E. vignai</i>	Greece, Karpathos Island, Arkasa	KC215649 (Parmakelis et al., 2013b)	KC215735 (Parmakelis et al., 2013b)

**Table 2:** DNA sequences used in the phylogenetic analysis.

## Ecology

The type locality of the new species in Alanya District, is located at the southern Mediterranean coast of Turkey, and has a typical Mediterranean climate. The highest and lowest annual temperatures recorded are 34.3 °C and 2.4 °C, respectively; and the annual temperature average is 20.5 °C. An average of 103 days is rainy in a year (Alanya Municipality, 2014). All specimens were collected from slopes and ridges lying parallel to the coastline, from the sea level up to a maximum of approximately 1,200 m on the peaks in the part of the Taurus Mountains range. Most of the specimens were collected on wall stones near a house (Fig. 24). The rest of the specimens were collected under rocks and in wall cracks near a road inside a pine forest (Fig. 23). Most of the collecting sites maintain high levels of humidity throughout the year. We observed that *Neocalchas gruberi* (Fet, Soleglad et Kovařík, 2009), *Protoiurus kraepelini* (von Ubisch, 1922), *P. kadleci* (Kovařík, Fet, Soleglad et Yağmur, 2010) (Iuridae), which are hygrophilic scorpions, and *Mesobuthus gibbosus* (Brullé, 1832) (Buthidae) which is xerophilic, are sympatric with *Euscorpium alanyaensis* sp. n. in the Taşatan Plateau.

## Comments

The taxonomy of the genus *Euscorpium* is complicated and still unresolved throughout its range. In addition, in Turkey the genus *Euscorpium* has been poorly studied, especially in the Mediterranean region, where, thanks to the influence of winds from the sea and the mountain ranges, the climate is milder and suitable for the species. Only recently studies to try to understand the distribution and taxonomic position of the Mediterranean populations of *Euscorpium* have been conducted and are currently in progress by our group. *E. alanyaensis* sp. n. is the fifteenth species of the genus *Euscorpium* in Turkey, and this is in line with the current trend of description of numerous new *Euscorpium* species, many of them endemic in a small area, in the Mediterranean region. Complex mountains, such as the Taurus in Turkey, form barriers thought to hinder the gene flow and contribute to the differentiation of populations. So, geographically and morphologically relatively close populations, actually have been quite divided and can be considered distinct species. This is the case of the new species, *E. alanyaensis* sp. n. and the similar species *E. gocmeni*, only about 50 km away from each other. Similar cases are present in several other species complexes throughout the range of distribution of the genus *Euscorpium*.

Herein we show for the first time a phylogeny including and comparing almost all Turkish species related to, but not included in, the subgenus *Euscorpium* (lacking just *E. rahsenae* currently under investigation). *E. gocmeni*, *E. alanyaensis* sp. n. and *E. koci* form a morphologically, geographically and phylogenetically well-supported group of species of the Central Taurus Mts., in the Turkish geographical Mediterranean region. These three species group together in our phylogenetic trees (*16S rDNA+COI*, *16S rDNA*, and *COI*, the latter two not shown). The genetic divergence between these species in *16S rDNA* is quite low, just between 1.7% and 2.5%. On the contrary, the *COI* genetic divergence is from 6.3% to 9.3%, namely well within the genetic divergence observed between many well defined and valid *Euscorpium* species (e.g. see Tropea et al., 2015b, 2016). According to our experience, the *COI* gene is more informative at the specific level in *Euscorpium* than *16S rDNA*, which, usually, is more reliable at higher levels. For example, it is notable that *E. lycius* has a divergence of just 2.3% with *E. scaber* in *16S rDNA*, although they are morphologically and geographically two well-separated species. At the same time, the divergence between these two species in *COI* ranges from 6.3% to 7.2% (within the range of divergence between populations of distinct species). According to the phylogeny (Fig. 20) re-constructed on *16S+COI*, the species more related to this group is *E. lycius*, which was quite expected given its range and morphology, but the relationship of the three Mediterranean species with the other *Euscorpium* species involved in the analysis are not well resolved. It seems that the relationships can change depending on the gene sequence and/or the method used to re-construct the phylogenetic tree (e.g. *16S rDNA* or *COI mtDNA*, Maximum Likelihood or Bayesian). However, what is obvious and not expected, is that in all phylogenetic analyses *E. gocmeni*, *E. alanyaensis* sp. n. and *E. koci*, as well *E. lycius*, do not group with any of the geographically near species, e.g. *E. avcii*, *E. vignai* or any of the species belonging to the *E. candiota* complex. On the contrary, they seem to be more closely related to species that are both morphologically and geographically more distant, such as *E. scaber* and *E. kinzelbachi* (both from northeastern Greece). Thus, *E. alanyaensis* sp. n., *E. gocmeni*, *E. koci* and *E. lycius*, which so far have not been assigned to any subgenus because of the obsolete diagnostic characters and of the paraphyly of the subgenus *Euscorpium* s.str., seem to be more closely related to species considered to belong to this subgenus. Therefore, based on the molecular data indications, these four species could actually be part of the subgenus *Euscorpium*. However, due to the unclear status of this subgenus, both morphologically and genetically, we chose not to include them in *Euscorpium* until more data become available.



Figures 21–22: Live specimens of *Euscorpius alanyaensis* sp. n. 21. male specimen. 22. female specimen.



Figures 23–24: Habitats where *E. alanyaensis* sp. n. was collected.

## Acknowledgments

We would like to thank Victor Fet for his availability and advice, and Dr. Recep Sulhi Özkütük, Efe Erdes, and Mert Elverici for their help during the field trips. We thank two anonymous reviewers for their comments.

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