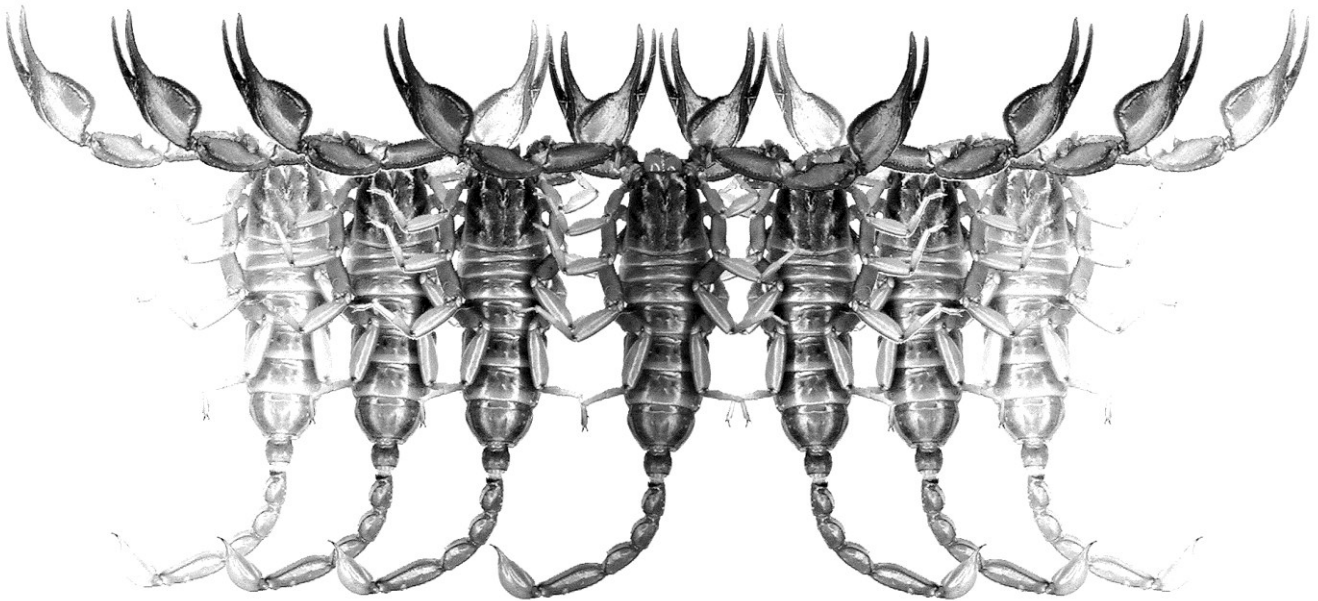


# *Euscorpilus*

Occasional Publications in Scorpiology



**Three New Species of *Euscorpilus*  
(Scorpiones: Euscorpilidae) from Greece**

**Gioele Tropea, Victor Fet, Aristeidis Parmakelis,  
Panayiota Kotsakiozi & Iasmi Stathi**

**October 2014 — No. 190**

# *Euscorpius*

## Occasional Publications in Scorpiology

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ASSOCIATE EDITOR: Michael E. Soleglad, 'soleglad@znet.com'

*Euscorpius* is the first research publication completely devoted to scorpions (Arachnida: Scorpiones). *Euscorpius* takes advantage of the rapidly evolving medium of quick online publication, at the same time maintaining high research standards for the burgeoning field of scorpion science (scorpiology). *Euscorpius* is an expedient and viable medium for the publication of serious papers in scorpiology, including (but not limited to): systematics, evolution, ecology, biogeography, and general biology of scorpions. Review papers, descriptions of new taxa, faunistic surveys, lists of museum collections, and book reviews are welcome.

### *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>  
(Marshall University, Huntington, West Virginia 25755-2510, USA)

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Between 2000 and 2013, ICZN *did not accept online texts* as "published work" (Article 9.8). At this time, *Euscorpius* was produced in two *identical* versions: online (*ISSN 1536-9307*) and CD-ROM (*ISSN 1536-9293*) (laser disk) in archive-quality, read-only format. Both versions had the identical date of publication, as well as identical page and figure numbers. *Only copies distributed on a CD-ROM* from *Euscorpius* in 2001-2012 represent published work in compliance with the ICZN, i.e. for the purposes of new names and new nomenclatural acts.

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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## Three new species of *Euscorpius* (Scorpiones: Euscorpiidae) from Greece

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### Summary

Three new species of the genus *Euscorpius* Thorell, 1876 are described from Greece: *E. stahlavskyi* sp.n. from Epirus in the northwestern Greece; *E. kinzelbachi* sp.n. from Mt. Olympus at the eastern border between Thessaly and Central Macedonia, and *E. vignai* sp.n. from Karpathos and Kasos Islands (eastern Aegean Sea). Species-level divergence of these taxa is also confirmed by multiple DNA markers in Parmakelis et al. (2013).

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### Introduction

The genus *Euscorpius* Thorell, 1876, widely spread in southern Europe and Anatolia, is one of the most studied scorpion taxa. Despite this, the taxonomy of this genus is very complicated and still far from being resolved. This is also true for Greece, where, especially due to lack of specimens from many areas, this genus has been poorly studied in the past. In addition, taxonomic studies are hindered by existence of cryptic species complexes, which are difficult to resolve even with phylogenetic analysis (Parmakelis et al. 2013; Tropea et al. 2014a). However, recently several studies delineated and described various new forms of this genus in Greece (Tropea & Rossi, 2012; Fet et al., 2013a, 2013b, 2014; Tropea et al., 2013). At present, 14 valid species are recognized in Greece (not including the new species): *E. avcii* Tropea et al., 2012; *E. birulai* Fet et al., 2014; *E. candiota* Birula, 1903; *E. corcyraeus* Tropea et Rossi, 2012; *E. erymanthius* Tropea et al., 2013; *E. hadzii* Di Caporiacco, 1950; *E. italicus* (Herbst, 1800); *E. koschewnikowi* Birula, 1900; *E. kritscheri* Fet et al., 2013; *E. mylonasi* Fet et al., 2014; *E. naupliensis* (C.L. Koch, 1837); *E. ossae* Di Caporiacco, 1950; *E. scaber* Birula, 1900; and *E. sicanus* (C.L. Koch, 1837). As a part of an ongoing revisionary study of Balkan

scorpions, we describe here three new species from Greece, *E. stahlavskyi* sp.n., *E. kinzelbachi* sp.n., and *E. vignai* sp.n., increasing the number of valid species of the genus *Euscorpius* in Greece to 17. Nevertheless, our data indicate that additional undescribed species of *Euscorpius* are also present in Greece and Bulgaria (Fet et al., in press; Tropea et al., in press).

### Methods and Material

The trichobothrial notation follows Vachon (1974). The morphological measurements are given in millimeters (mm) following Tropea et al. (2014b). The morphological nomenclature follows Stahnke (1970), Hjelle (1990), and Sissom (1990); the chela carinae and denticle configuration follows Soleglad & Sissom (2001); and sternum terminology follows Soleglad & Fet (2003).

### 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 sub-terminal; *em*: exter-

nal medium; *esb*: external suprabaasal; *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., 2014a); *Lcar*: carapace length; *Wcar*: carapace width; *Lfem*: femur length; *Lpat*: patella length; *Lmet*: metasoma length; *met.seg*: metasomal segment; *CarA/CarP* %: average 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.

GTC, personal collection of Gioele Tropea, Rome, Italy; FKCP, personal collection of František Kovařík, Prague, Czech Republic; MNHNP, Muséum National d'Histoire naturelle, Paris, France; MSNB, Museo Civico di Scienze Naturali "E. Caffi", Bergamo, Italy; MNSG, Museo Civico di Storia naturale "Giacomo Doria", Genoa, Italy; MZUR, Museo di Zoologia dell'Università di Roma "Sapienza" Charles Darwin, Rome, Italy; NHMC, Natural History Museum of Crete, University of Crete, Heraklion, Crete, Greece; NHMW, Naturhistorisches Museum Wien, Vienna, Austria; NMM, City Museum of Mainz, Mainz, Germany; NMNHS, National Museum of Natural History, Sofia, Bulgaria; PMGPC, private collection of Pier Mauro Giachino, Torino, Italy; VFPC: personal collection of Victor Fet, Huntington, West Virginia, USA; ZMB, Zoologisches Museum Berlin, Humboldt-Universität, Berlin, Germany.

### Material Studied

A detailed list of material with label data is given under each species. In addition, 24 specimens of *E. ossae* were analyzed for comparison: Thessaly, near Karitsa, Mt. Ossa, 20 October 1974, leg. A. Vigna, 3 ♀ (MSNB 10013–10015); same data, leg. A. Bianchi, 1 ♀ (MSNB 10020); Mt. Ossa, road Spilia–Anatoli, 6 May 2012, leg. Z. Lucbauer, 1 ♂, 1 ♀ (GTC 254, 255); Thessaly, Mt. Ossa, Karitsa–Anatoli, 18 km before Anatoli, 39°47'N, 22°45'E, 31 July 2001, leg. S. Simaiakis, 3 ♂, 6 ♀ (NHMC 2212, Eus45); Thessaly, Mt. Ossa, Spilia, refuge, 39°48'N, 22°39'E, 28 July 2001, leg. S. Simaiakis, 3 ♂, 6 ♀ (NHMC 2203, Eus43); Thessaly, Mt. Ossa, Spilia, refuge, 1550 m, 39°48'N, 22°41'E, 09 July 2001, leg. S. Simaiakis, 3 ♀ (NHMC 2204, Eus44).

Nomenclature for reporting DNA sequences from holotype ("geneseq-1"), paratype ("geneseq-2") and non-type ("geneseq-3") specimens follows Chakrabarty et al. (2013).

### DNA Analysis and Species Validation

Validity of three described new species was supported by our molecular phylogenetic study of *Euscorpius* populations across Greece (Parmakelis et al., 2013). Several methods of species delimitation and a species validation method were employed in Parmakelis et al. (2013) based on the phylogeny inferred using sequence data from one nuclear and three mtDNA loci. For details on molecular and phylogenetic analysis, see Parmakelis et al. (2013).

In almost all species delimitation methods, the three *Euscorpius* species described herein were strongly supported as corresponding to independent evolutionary units. Out of the three new species described in this paper, only *E. kinzelbachi* sp.n. from Mt. Olympus appears to belong to the nominotypic subgenus *Euscorpius* s.str., as a sister species to *E. ossae* from Mt. Ossa in Thessaly (see Fet et al., 2013a, for detailed redescription of *E. ossae*) (Fig. 55). The two other new species, *Euscorpius stahlavskyi* sp.n. and *E. vignai* sp.n., are placed in a basal position, and therefore do not form a part of the traditional (nominotypic) subgenus *Euscorpius* s.str., further confirming the latter's paraphyly (Tropea, 2013; Parmakelis et al., 2013). See Fig. 55 for placement of all new species described herein as well as those described in Fet et al. (2013b, 2014) and Tropea et al. (2013).

### Systematics

Genus *Euscorpius* Thorell, 1876

Subgenus Incertae Sedis

*Euscorpius stahlavskyi* Tropea, Fet, Parmakelis, Kotsakiozi et Stathi, **sp. nov.**  
(Figs. 1–19; Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:41F12631-2969-444E-A839-06FE3223F97D>

### REFERENCES:

*Euscorpius* sp. Clade E0 (in part): Parmakelis et al., 2013: 740.

**Type material** (18 specimens: 14 ♂, 4 ♀). **Holotype**: ♂, GREECE, *Epirus*: Ioannina, Konitsa, Smolikias Mts. above Palioseli, 1630 m, 40°04'15.2"N, 20°53'22.0"E (40.070889°N, 20.889444°E), 17 June 2007–16 June 2008, leg. P.M. Giachino & D. Vailati (PMGPC Sc31). **Paratypes**: GREECE, *Epirus*: same label as holotype, 7 ♂, 1 ♀, 5 imm. (PMGPC Sc31), 3 ♂, 1 ♀ (GTC), 3 ♂, 1 ♀ (MSNB); Ioannina, Konitsa, Smolikias Mts., 1600 m, 2 km before the mountain refuge, 40.092088°N, 20.848358°E, 5 July 2005, leg. M. Mylonas, 1 ♀ (NHMC 7308, 81.1.1.51, Eus77).



**Figures 1–2:** *Euscorpius stahlavskyi* sp. n., male holotype. 1. Dorsal view. 2. Ventral view.

**Other material examined (not included in type series)** (17 specimens: 4 ♂, 8 ♀, 5 imm.): GREECE, *Epirus*: same label as holotype, 5 imm. (PMGPC Sc31); Zagori, Vikos Gorge, Papingo, 39.966667°N, 20.716667°E, 9 April–14 May 2008, ‘scorp14’, leg. F. Štáhlavský, 1 ♀ (VFPC); Ioannina, Pogoniskos, W of Nemertsilo, 900 m, in the gorge, 25 June 2010, leg. P. Lymberakis, 1 ♂ (NHMC 12818, Eus42); Ioannina, Konitsa, Voidomatis

River near Kalyvia, 440 m, 39.96860123°N, 20.66230011°E, 5 July 2005, leg. K. Vardinoyannis, 6 ♀ (NHMC 7305, 81.1.1.59, Eus20); Ioannina, Konitsa, 1.5 km before Eleftera, from Konitsa to Palioseli, 900 m, 40.06280136° N, 20.84140015° E, 5 July 2005, leg. M. Mylonas, 1 ♂, 1 ♀ (NHMC 7307, 8.1.1.58); Ioannina, Konitsa, Smolikas Mts., 1600 m, 2 km before the mountain refuge, 40.092088°N, 20.848358°E, 5 July 2005,



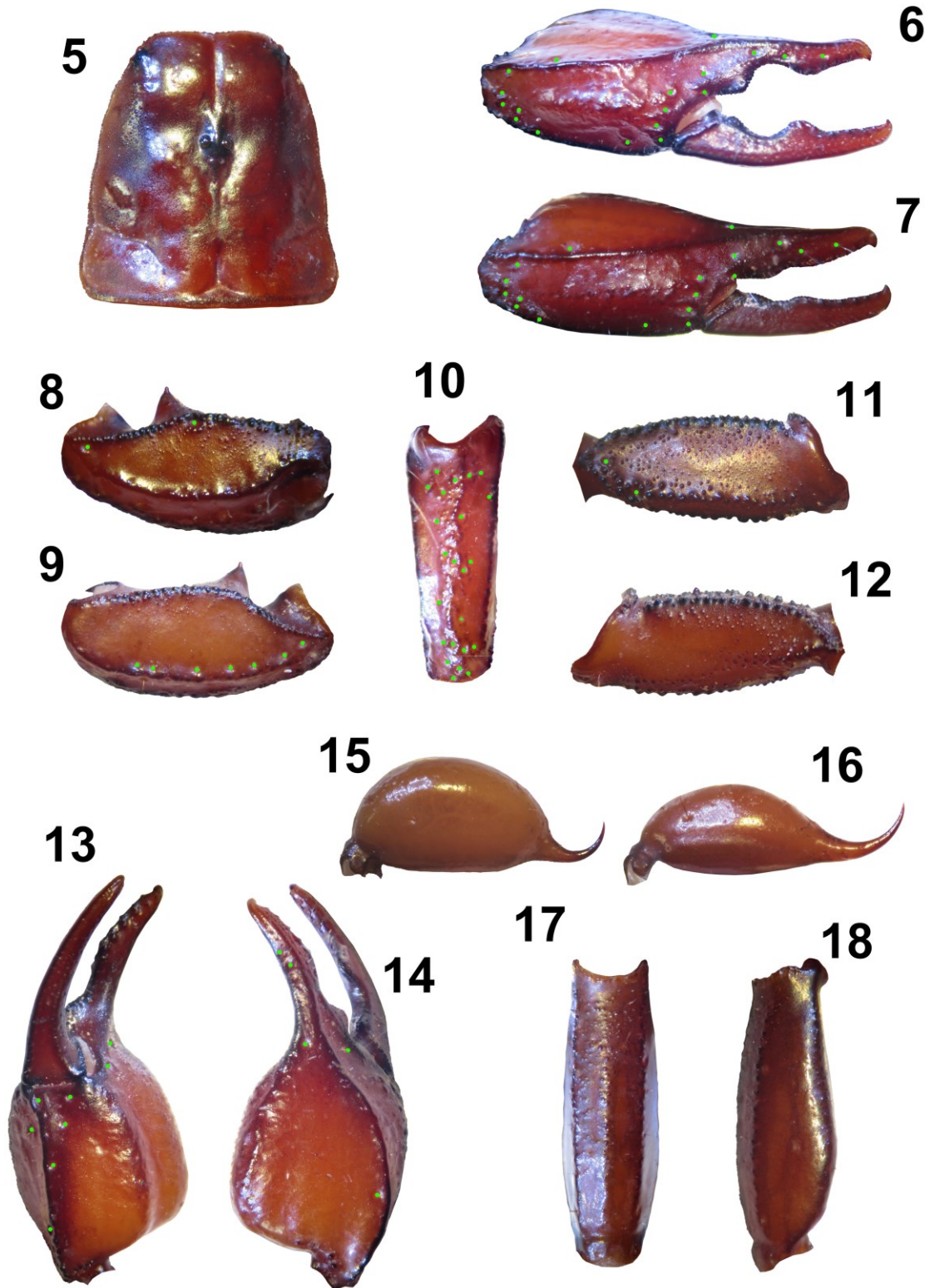
**Figures 3–4:** *Euscorpius stahlavskyi* sp. n., female paratype. **3.** Dorsal view. **4.** Ventral view.

leg. M. Mylonas, 1 ♂ (NHMC 7308, 81.1.1.51, Eus77); Ioannina, Konitsa, Smolikas Mts., 200 m, 6 July 2005, leg. M. Mylonas, 1 ♂ (NHMC 7310, 81.1.1.57).

**DNA sequences** (Parmakelis et al., 2013: 740): GREECE, *Epirus*: Ioannina, Konitsa, Smolikas Mts, 1600 m, 2 km before the mountain refuge, 40.092088°N, 20.848358°E, 5 July 2005, leg. M. Mylonas (NHMC 7308, 81.1.1.51), EC202, geneseq-2: 16S, COII, ITS1 (GenBank accession numbers: KC215605, KC215774,

KC215860) but not COI, see Notes; Vikos Gorge, Papingo, 39.966667°N, 20.716667°E, 9 April–14 May 2008, ‘scorp14’, leg. F. Šťáhlavský (VFPC), FESP33, geneseq-3: 16S, COI, COII, ITS1 (GenBank accession numbers: KC215653, KC215739, KC215824, KC215909); Ioannina, Konitsa, Voidomatis River near Kalyvia, 440 m, 39.96860123°N, 20.66230011°E, EC210, geneseq-3: 16S, COI, COII, ITS1 (GenBank accession numbers: KC215614, KC215698, KC215783, KC215869); Ioannina, Konitsa, 1.5 km before Elefthera, road





**Figures 5–18:** *Euscorpium stahlavskyi* sp. 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.



**Figure 19:** *Euscorpius stahlavskyi* sp. n., male holotype, ventral view of leg tarsus.

from Konitsa to Palioseli, 900 m, 40.06280136°N, 20.84140015°E, 5 July 2005, leg. M. Mylonas (NHMC 7307, 8.1.1.58), EC209, geneseq-3: 16S, COI, COII, ITS1 (GenBank accession numbers: KC215613, KC215697, KC215782, KC215868).

**Etymology:** Named after our colleague, Dr. František Štáhlavský (Prague, Czech Republic) who pioneered studies of *Euscorpius* karyotypes, and who collected one of the specimens used for DNA analysis of this new species.

**Geographic range:** Northwestern Greece, Epirus, northwestern part of the Pindos Mountains (Fig. 54).

**Diagnosis.** A medium to medium-large *Euscorpius* species, total length 30–39 mm (average 34.54). Color of adults light to medium brown/reddish, carapace darker. Reticulation or marbling always present on the metasoma, and varying from absent to weak to highly marked on carapace and mesosoma. Poorly granulated metasomal carinae, except on segment V, which has granulated carinae. 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 7, more rarely 8 (7 in 75.93 % and 8 in 16.67 % of pedipalps examined). The number of trichobothria on pedipalp patella external surface is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 4$ ,  $est = 4$ ,  $et = 5$  to 6 (series  $et = 5$  in 48.15 % and 6 in 50.00 % of pedipalps examined). The pectinal teeth number in males is 7 to 8 (7 in 46.88 % and 8 in 50.00 % of pectines examined); in females usually 6 (in 86.36 %) more rarely 7 (in 13.64 % of pectines examined).  $Lchel/Wchel$  ratio is 2.523 in males and 2.672 in females. Dorsal patellar spur well-developed. Femur usually is slightly longer than patella or as long as it, but could be also slightly shorter than patella;  $Lfem/Lpat$  ratio is 1.013. Carapace could be both slightly longer than wide (mostly in males), and slightly wider than long (mostly in females); average ratio

$Lcar/Wcar$  1.022 in males and 0.997 in females; average distance from center of median eyes to anterior margin of the carapace is 40.92 % of the carapace length. Average ratio of  $Lmet/Lcar$  is 2.854 in males and 2.549 in females.

**Trichobothrial and pectinal teeth count variation.**

The variation observed in 27 studied specimens (16 ♂, 11 ♀) is given below.

**Pectinal teeth in males:** 7/7 (6), 7/8 (2), 8/7 (1), 8-8 (6), 8-9 (1); in total, 7 (15, or 46.88 %) and 8 (16, or 50.00); mean = 7.56, SD = 0.56 (n=32).

**Pectinal teeth in females:** 6/6 (8), 6/7 (3); in total, 6 (19, or 86.36 %) and 7 (3, or 13.64 %); mean = 6.14, SD = 0.35 (n=22).

**Pedipalp patella trichobothria Pv:** 6/7 (2), 7/6 (2), 7/7 (17), 7/8 (3), 8/8 (3); in total, 7 (41, or 75.93 %) and 8 (9, or 16.67 %); mean = 7.09, SD = 0.47 (n=54).

**Pedipalp patella trichobothria Pe:**  $et = 5/3$  (1),  $5/5$  (10),  $5/6$  (2),  $6/5$  (4),  $6/6$  (10); in total, 5 (26, or 48.15 %) and 6 (27, or 50.00 %); mean = 5.44, SD = 0.60 (n=54); in all specimens,  $est = 4/4$ ;  $em = 4/4$ ;  $esb = 2/2$ ;  $eb_a = 4/4$ ;  $eb = 4/4$ .

**Hemispermatochore.** Both right and left hemispermatochore of three specimens were studied. They have a well-developed lamina tapered distally; well-developed basal constriction present; truncal flexure present; median projection with primary and secondary acuminate processes; internal projection distally show 9–11 tines in its crown. The number of tines of the crown could differ between specimens and between the right and the left hemispermatochore and are often forked. The shape of the secondary acuminate processes could differ between specimens and between the right and the left hemispermatochore.

**Description of the male holotype**

**Coloration:** Whole color medium brown with carapace darker and legs, telson and chelicerae lighter; weak marbling on carapace, tergites and metasoma; sternites and pectines and genital operculum very light brownish/ivory; chelicerae very light, yellowish/light brownish with darker fingers and finger teeth much darker, palms without marbling; telson yellowish, with a longitudinal darker line and dark reddish aculeus tip; all carinae darker, dark brown to blackish colored.

**Carapace:** A very fine granulation on whole surface is present, except in the anterior area between the anterior edge, the lateral eyes and median eyes, which is almost smooth, very finely punctated and glossy, and the lateral area behind the lateral eyes, which has greater and marked granules; anterior edge granulate and more or less straight; very deep posterior lateral furrows; two pairs of lateral eyes (with a larger anterior eye), and a



pair of median eyes, situated distally of the middle; distance from center of median eyes to anterior margin is 41.01 % of carapace length.

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

**Metasoma:** Dorsal carinae on segments I–IV with spaced granules; dorsolateral carinae on segments I barely traceable with very few, small, spaced granules, in the proximal area, on segments II–V absent or obsolete; ventrolateral carinae absent on segment I, obsolete or smooth on segments II–IV, granulated to serrulated on segment V; ventromedian carina absent on segments I–IV, the V segment from weakly granulated in the proximal area to irregularly granulated/serrulated, with the distal area indistinguishable from the granulation of the surface; dorsal intercarinal spaces with a very fine granulation, most evident on the segments IV and V, smooth or almost smooth on the lateral and ventral surface, except the V segment surface, which is very granulated on the distal 1/3 of the length, and well granulated only laterally on 2/3 of the length.

**Telson:** Vesicle with a few scattered, very small granules to rough, 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; genital papillae protruding; a few microsetae are present.

**Sternum:** Pentagonal shape, type 2; slightly wider than long, 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 tubercles; external median carinae serrulated; ventral external carinae formed by spaced tubercles, well-formed only in the proximal 1/3; anterior median formed by spaced conical tubercles, varying in size, of which three are greater and well-marked with a macroseta each; dorsal and ventral intercarinal spaces with granules of variable size, greater near the carinae. Patella: dorsal and ventral internal carinae tuberculated to granulated; dorsal external carinae rough; ventral external carinae from rough to granulated; dorsal intercarinal surface with granules of variable size, greater near the internal carinae and in distal area; ventral intercarinal surface from smooth to few scattered minute granules, especially near ventral internal carinae. Dorsal patellar spur well developed. Chelal carina *D1* is distinct, strong, dark, smooth to rough; *D4* is rounded and rough; *V1* is distinct, strong, dark and rough with a few tubercle serrulates proximally; *V3* rounded, dark and lightly and finely granulated; external carina granulated;

intercarinal tegument rough with granules of variable size. Typical *Euscorpius* chela finger dentition.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 ( $V_{1-3} + Et_1$ ). Patella ventral (*Pv*): 7/7. Patella external (*Pe*):  $et = 5/5$ ,  $est = 4/4$ ,  $em = 4/4$ ,  $esb = 2/2$ ,  $eb_a = 4/4$ ,  $eb = 4/4$ . 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 10/11 spinules, of increasing size from proximal to distal, ending with a decentralized spinule; 3 flanking pairs of tarsal setae adjacent to the ventral spinule row. Basitarsus with 2 to 9 prolateral spinules, with increasing number from legs IV to I. Granulation well present on dorsal and ventral surface of 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 brush-like 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 brush-like setae.

## Notes

1. The DNA phylogeny (Parmakelis et al., 2013) places this species in a more basal clade (E0 in part) than most of other *Euscorpius*. This implies that *E. stahlavskyi* sp. n. is not part of the subgenus *Euscorpius* s.str.; here, we do not assign it to any subgenus.

2. In Parmakelis et al. (2013), clade E0 is subdivided into three main subclades; EC202; EC208; and a group of three sequences (EC209 + EC210 + FESP33) (see our Fig. 55). *E. stahlavskyi* sp. n. corresponds to this last subclade, which includes specimens from the western slope of Smolikas Mts. to Vikos Gorge near Papingo, from 200 to 1630 m a.s.l. The clade EC208 refers to a population from the eastern slope of Smolikas Mts., which is not included in *E. stahlavskyi* sp. n. in this work (it also groups close to 16S sequence from Vasilitza, West Macedonia, unpublished). Finally, for the subclade EC202, we need to report an error in Parmakelis et al. (2013). Three markers (16S, COII, ITS1) sequenced from this population (Smolikas Mts, 2 km before the mountain refuge, 1600 m), in fact, also cluster with *E. stahlavskyi* sp. n. (subclade EC209 + EC210 + FESP33); however, the COI sequence published under EC202 (KC215689) belongs to another species (*E. sicanius* complex). Thus the clade E0 forms only two main subclades.

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**Figures 20–21:** *Euscorpius kinzelbachi* sp. n., male holotype. **20.** Dorsal view. **21.** Ventral view.

3. Like *Euscorpius ossae* (see Fet et al., 2013a) and *E. kinzelbachi* sp. n. (see below), *E. stahlavskyi* sp. n. is sympatric with forms belonging to *E. sicanius* complex, the most widespread group of *Euscorpius* in Southern Europe (Southern Italy and Greece). These two species can be distinguished mainly because *E. sicanius* complex has the trichobothrial series *eb* = 5 versus *eb* = 4 in *E. stahlavskyi* sp. n. In addition, *Euscorpius stahlavskyi* sp. n. is sympatric with *E. (Polytrichobothrius) italicus*, which was collected in the same localities: Voidomatis River near Kalyvia, 440 m; 1.5 km before Elefthera, road from Konitsa to Palioseli, 900 m (Parmakelis et al., 2013).

Subgenus *Euscorpius* Thorell, 1876

*Euscorpius kinzelbachi* Tropea, Fet, Parmakelis, Kotsakiozi et Stathi, **sp. nov.**

(Figs. 20–38; Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:8788DF49-45E2-46E4-A5BB-3D5EF95A0F7A>

#### REFERENCES:

- Euscorpius carpathicus* s.str. (in part; Mt. Olympus): Kinzelbach, 1975: 30, 36  
*Euscorpius carpathicus* (in part; Mt. Olympus): Kinzelbach, 1982: 60–61; Stathi & Mylonas, 2001: 289.

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Figures 22–23: *Euscorpium kinzelbachi* sp. n., female paratype. 22. Dorsal view. 23. Ventral view.

*Euscorpium carpathicus* “Subgroup A1” (in part; Mt. Olympus): Fet, 2000: 52.

*Euscorpium ossae* (Clade E9, in part; Mt. Olympus): Parmakelis et al., 2013: 740.

**Type material** (33 specimens: 7 ♂, 26 ♀): **Holotype**: ♂, GREECE. *Thessaly*: Mt. Olympus, around Naoum Cave, pine forest, 1375 m, 40.10329819°N, 22.32180023°E, 3 June 2007, leg. M. Mylonas (NHMC 10053; 81.1.1.61, Eus2). **Paratypes**: GREECE. *Thessaly*: same label as holotype, 2 ♂ (1 adult and 1 imm.), 9 ♀ (8 adults and 1 imm.) (NHMC 10053, 81.1.1.61, Eus2), 1 ♂, 2 ♀ (GTC); Kokkinopilos, 4.2 km to Tsoureka spring, 1200

m, 4 June 2007, leg. M. Mylonas, 1 ♂, 5 ♀ (NHMC 10056, Eus1), 1 ♂, 1 ♀ (GTC); Mt. Olympus, 2100 m, near refuge of Alpine Club [“Spilios Agapitos”], leg. Mission A. Bertrand, 14 June 1955, 1 ♀ (MNHNP RS 2970); Mt. Olympus, 1800 m, July 1972, leg. A. Villiers, 1 ♂ (MNHNP RS 7686); Mt. Olympus, near Prionia, 1500 m, 1 ♀ (FKPC). *Central Macedonia*: Mt. Olympus, foothills, Litochoro, July 1997, leg. M. Švarc, 1 ♂ (FKPC).

**Other material examined (not included in type series)** (29 specimens: 12 ♂, 12 ♀, 7 juv): GREECE. *Thessaly*: Mt. Olympus, 2100 m, 3 July 1936, leg. Kr. Tuleschkov,

1 ♂ (NMHNS); Mt. Olympus, 2000 m, 6 July 1936, leg. D. Papazov, 7 juv. (NMNHS); 1 ♂, Mt. Olympus, 1700 m, 17 September 1974, leg. P. Beron & V. Beshkov (NMHNS 55); Mt. Olympus, east portion, 14 June 1973, leg. H. Schmalzfuss, 1 ♂, 1 ♀ (ZMM 0199a); Mt. Olympus, Agios Dionysios Monastery, 820 m, 28 August and 10 September 1973, leg. H. Pieper, 1 ♀ (ZMM 0209); Mt. Olympus, Karia, 800 m, 26 May 1974, leg. H. Malicky, 1 ♂ imm., 1 ♀ (ZMM 0261); SMt. Olympus, 1200 m, Oxias Forest, 4 June 2007, leg. M. Mylonas, 2 ♂, 6 ♀, 2 juv. (NHMC 10056, 81.1.1.52-54); Mt. Olympus, 1305 m, E from Kokkinopilos, 10 June 2003–23 June 2004, leg. P.M. Giachino & D. Vailati, 1 ♂ imm. (MSNG, PMGC Sc71); Mt. Olympos, Kokkinopilos, 1070 m, groove in beech forest, 10 June 2003–23 June 2004, leg. P.M. Giachino & D. Vailati, 1 ♂ imm. (MSNG, PMGC Sc72); Mt. Olympus, near Prionia, 1500 m, 1♂, 4♀ (FKPC). *Central Macedonia*: Mt. Olympus, foothills, Litochoro, July 1997, leg. M. Švarc, 1 ♂ (FKPC); Mt. Olympus, foothills, 3 km N Litochoro, 15 May 2001, leg. V. Fet, 2 ♀ (VFPC).

**DNA sequences** (Parmakelis et al., 2013: 740): GREECE. *Thessaly*: Mt. Olympus, Naoum Cave, 1375 m, 40.10329819°N, 22.32180023°E, 3 June 2007, leg. M. Mylonas (NHMC 10053, Eus2), EC212, geneseq-1: 16S, COI, COII, ITS1 (GenBank accession numbers KC215615, KC215699, KC215784, KC215870); Mt. Olympus, Kokkinopilos, 4.2 km to Tsoureka spring, 1200 m, 4 June 2007, leg. M. Mylonas (NHMC 10056, Eus1), EC205, geneseq-2: 16S, COI, COII, ITS1 (GenBank accession numbers KC215610, KC215694, KC215779, KC215865).

**Etymology.** Named after our colleague, Prof. Ragnar Kinzelbach (Rostock, Germany), whose research greatly contributed to the current knowledge of Aegean and Anatolian scorpions.

**Geographic range.** Known only from Mt. Olympus massif, Thessaly and Macedonia, Greece (Fig. 54).

**Diagnosis:** A medium to medium-large *Euscorpius* species, usually 33–35 mm long (range 30–39 mm, mean 34.7 mm). Color of adults medium-light to medium-dark brown, with carapace darker. Weak to marked reticulation or marbling on chelicerae, carapace, mesosoma and metasoma 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 8 (in 73.17 %), more rarely 7 (in 21.95 % of pedipalps examined). The number of trichobothria on pedipalp patella external surface usually is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 4$ ,  $est = 4$ ,  $et = 6$ . The pectinal teeth number in males is 8 to 10, and in females usually 7 to 8 (7 in 42.31 % and 8 in

51.92 % of the pectines examined).  $Lchel/Wchel$  ratio is 2.637 in males and 2.706 in females. Dorsal patellar spur well-developed. Femur could be slightly longer to slightly shorter than patella;  $Lfem/Lpat$  ratio is 0.996. Carapace could be either slightly longer than wide (mostly in males) or slightly wider than long (mostly in females); average ratio  $Lcar/Wcar$  1.039 in males and 1.003 in females; average distance from center of median eyes to anterior margin of the carapace is 41.05 % of the carapace length. Average ratio of  $Lmet/Lcar$  is 2.696 in males and 2.479 in females.

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

The variation observed in 42 studied specimens (16 ♂, 26 ♀) is given below.

*Pectinal teeth in males:* 8/8 (1), 8/9 (2), 9/8 (2), 9/9 (5), 10/9 (2), 10/10 (4); in total, 8 in 6 (18.75 %), 9 in 16 (50.00 %), and 10 in 10 (31.25 %); mean = 9.13, SD = 0.71 (n=32).

*Pectinal teeth in females:* 6/7 (1), 7/7 (7), 7/8 (4), 8/7 (3), 8/8 (10), 9/9 (1); in total, 6 in 1 (1.92 %), 7 in 22 (42.31 %), 8 in 27 (51.92 %), and 9 in 2 (3.85 %); mean = 7.58, SD = 0.61 (n=52).

*Pedipalp patella trichobothria Pv:* ?/7 (1), 7/7 (4), 7/8 (9), 8/6 (1), 8/8 (23), 8/9 (2), 9/8 (1), 9/9 (1); in total, 6 in 1 (1.22 %), 7 in 18 (21.95 %), 8 in 60 (73.17 %), and 9 in 4 (4.88 %); mean = 7.81, SD = 0.53 (n=83).

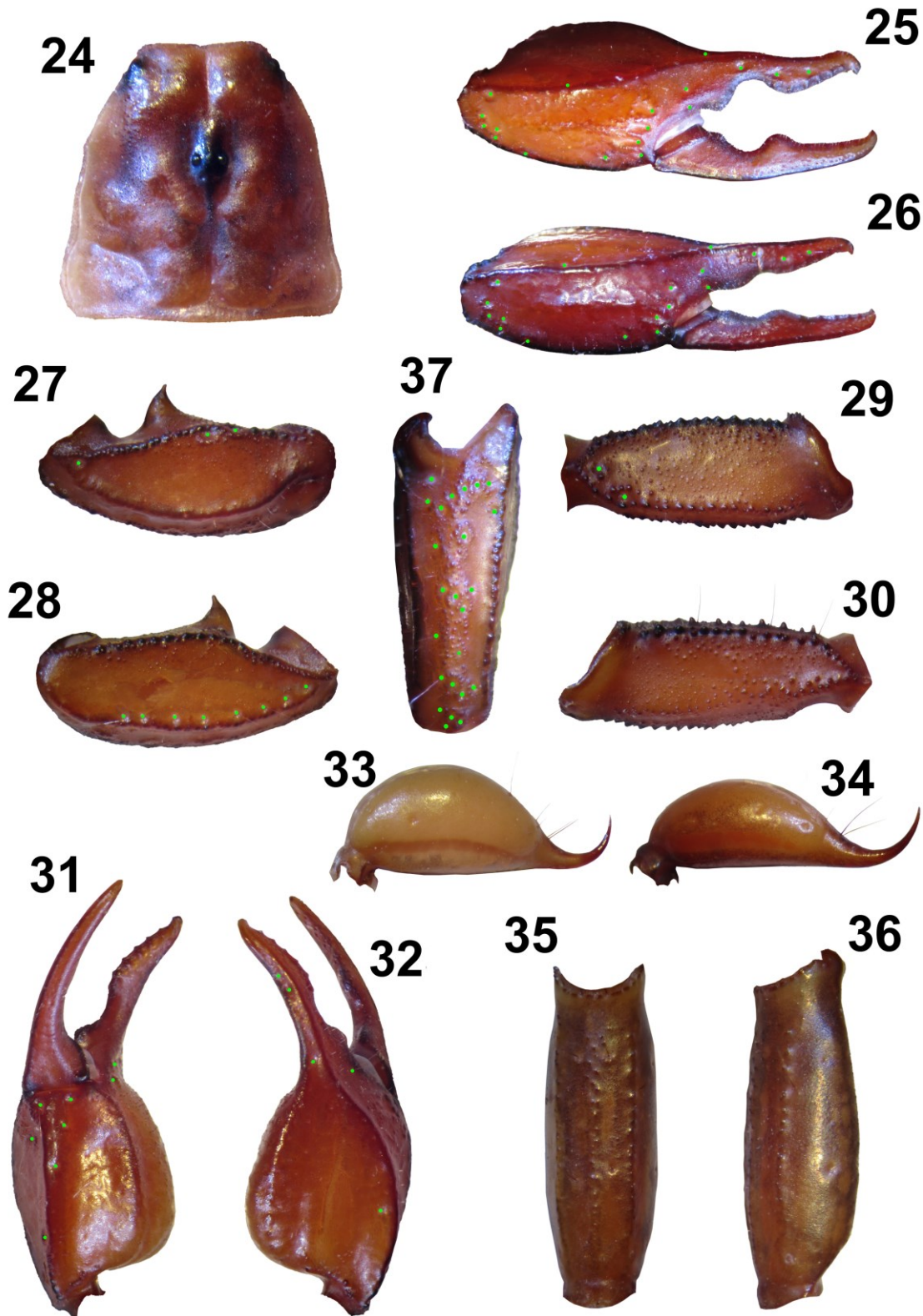
*Pedipalp patella trichobothria Pe:*  $et = 5/5$  (2),  $5/6$  (2),  $6/4$  (1),  $?/6$  (1),  $6/6$  (34),  $6/7$  (2), in total, 4 in 1 (1.20 %), 5 in 6 (7.23 %), 6 in 74 (89.16 %), and 7 in 2 (2.41 %); mean = 5.93, SD = 0.36 (n=83);  $est = ?/4$  (1),  $4/3$  (1),  $4/4$  (40),  $5/4$  (1);  $em = ?/4$  (1),  $2/4$  (1),  $4/4$  (40);  $esb = ?/2$  (1),  $2/1$  (1),  $2/2$  (39),  $2/3$  (1),  $3/3$  (1);  $eb_a = ?/4$  (1),  $4/4$  (41);  $eb = ?/4$  (1),  $4/4$  (41).

**Hemispermatothore.** Both right and left hemispermatothores of two specimens were studied. They have a well-developed lamina tapered distally; well-developed basal constriction present; truncal flexure present; median projection with primary and secondary acuminate processes; internal projection distally show 9–12 tines in its crown. The number of tines of the crown could differ between specimens and between the right and the left hemispermatothores. The shape of the secondary acuminate processes varies between specimens and between the right and the left hemispermatothores.

#### **Description of the male holotype**

**Coloration:** Whole color medium brown with carapace darker, brown/reddish, and legs, telson and chelicerae lighter; more or less expressed marbling on carapace, tergites, metasoma and chelicerae; sternites and pectines and genital operculum very light brownish/ivory; chelicerae very light, yellowish/light





**Figures 24–37:** *Euscorpium kinzelbachi* sp. n. 24. Carapace. 25. External view of the chela of adult male. 26. External view of the chela of adult female. 27. Dorsal view of pedipalp patella. 28. Ventral 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. 37. External view of pedipalp patella.





**Figure 38:** *Euscorpium kinzelbachi* sp. n., female holotype, ventral view of leg tarsus.

brownish with darker finger teeth, palms with slight marbling; telson yellowish, with a longitudinal darker line and dark reddish aculeus tip; all pedipalp carinae darker, dark brown to blackish colored.

**Carapace:** Marked granulation of variable size on whole surface is present, except in the anterior area between the anterior edge, the lateral eyes and median eyes, which is almost smooth. The lateral area behind the lateral eyes has greater and marked granules; anterior edge granulate and concave; median anterior, median posterior, and posterior lateral furrows well evident; two pairs of lateral eyes (with a larger anterior eye), and a pair of median eyes, situated distally of the middle; distance from center of median eyes to anterior margin is 41.66% of carapace length.

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

**Metasoma:** Dorsal carinae on segments I–IV with little spaced granules, with the last two distal granules well-marked on segments II–IV; dorsolateral carinae on segments I barely traceable with very few, small, spaced granules, in the proximal area, on segments II–V absent or obsolete; ventrolateral carinae absent on segment I, obsolete or smooth on segments II–IV, granulated to serrulated on segment V; ventromedian carina absent on segments I–IV, granulated on segment V; dorsal intercarinal spaces with a very fine granulation, from smooth to very fine and scattered granules on the lateral and ventral surface.

**Telson:** Vesicle with a few scattered, very small granules, with ventral setae of different size, especially near the vesicle/aculeus juncture.

**Pectines:** Teeth number 9/9; 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 separate subtriangular

sclerites; genital papillae protruding; a few microsetae are present.

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

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal carinae tuberculated; dorsal external carinae formed by tubercles slightly spaced and serrulated; external median carinae serrulated; ventral external carinae formed by spaced tubercles, well-formed only in the proximal 1/3, then it merges with the surrounding granulation; anterior median formed by spaced 8–10 conical tubercles, varying in size, of which three are greater and well-marked with a macroseta each; dorsal and ventral intercarinal spaces with granules of variable size, greater near the carinae. Patella: dorsal and ventral internal carinae tuberculated to granulated; dorsal external carinae from rough to slightly crenulated; ventral external carinae from granulated, slightly serrulated; dorsal intercarinal surface from almost smooth to granulated with granules of variable size, greater near the internal carinae and in distal area; ventral intercarinal surface most smooth with a few scattered small granules, especially near ventral internal carinae. Dorsal patellar spur well developed. Chelal carina *D1* and *V1* are distinct, strong, dark and mostly smooth with a few granules proximally; *D4* and *V3* rounded, dark, lightly and finely granulated; external carina granulated; intercarinal tegument rough with granules of variable size. Typical *Euscorpium* chela finger dentition.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 ( $V_{1-3} + Et_1$ ). Patella ventral (*Pv*): 7/8. 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 12/14 spinules, all on a single line; 3 flanking pairs of tarsal setae adjacent to the ventral spinules row. Basitarsus with from 2 to 10 prolateral spinules, of increasing number from legs IV to I. Granulation present on dorsal and ventral surface of leg femora, it is mostly marked and dark ventrally (except the right femur of leg II, which is slightly deformed).

**Chelicerae:** Movable finger: the dorsal distal denticle is very 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, two small subdistal, one large median and a small basal. Fixed finger: it has 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.

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**Figures 39–40:** *Euscorpium vignai* sp. n., female holotype. 39. Dorsal view. 40. Ventral view.

#### Notes

1. Kinzelbach (1975: 31–36, figs. 13–16, table 2) was the first to recognize that Mt. Olympus harbors two sympatric *Euscorpium* species, “*E. carpathicus* s.str.” (our *E. kinzelbachi* sp. n.) and a species which Kinzelbach addressed as “*E. mesotrichus* Hadži, 1929” (an unavailable name, which in this case refers to a species of *E. sicanus* complex). Kinzelbach’s Mainz collection (NMM) contains specimens of both species; most belong to *E. sicanus* complex, as well as all specimens collected on Mt. Olympus by Kritscher

(1993: 386). The same ecological pattern was observed for sympatric *E. sicanus* complex form and *E. ossae* on Mt. Ossa (Fet et al., 2013a).

2. DNA phylogeny (Parmakelis et al., 2013) places this species in the same clade (E9) with the sister species *E. ossae* from Mt. Ossa, Thessaly (Fig. 55). We compared 42 studied specimens (16 ♂, 26 ♀) of *E. kinzelbachi* sp. n. to 24 specimens (7 ♂, 17 ♀) of *E. ossae*. These two species are also morphologically very similar, and their differences are variable and overlapping. *E. kinzelbachi* sp. n. differs from *E. ossae* pri-

marily by (1) the higher number of external terminal trichobothria (*et*) on pedipalp patella, which on average was 5.93 (6 in 89.16 %) in *E. kinzelbachi* sp. n. versus 5.37 (5 in 63.05 % and 6 in 36.95 %) in *E. ossae*\*; (2) the higher number of ventral trichobothria on pedipalp patella (*Pv*), which on average was 7.81 (7 in 21.95 % and 8 in 73.17 %) in *E. kinzelbachi* sp. n. versus 7.04 (7 in 83.33 %, 8 in 10.41, and 6 in 10.66 %) in *E. ossae*; (3) the higher number of pectinal teeth in females, which on average was 7.58 (7 in 42.31 % and 8 in 51.92%) in *E. kinzelbachi* sp. n. versus 7.12 (7 in 88.24 % and 8 in 11.76%) in *E. ossae*. In addition, *E. kinzelbachi* sp. n. could show a greater variability in coloration, having both specimens medium-light to dark brown.

\* Most of the specimens of *E. ossae* with *et* = 6 were collected near Spilia, while the specimens with *et* = 5 were collected from more peripheral zone to south and east of this area.

3. In *E. kinzelbachi* sp.n., the ventral row of spinules on tarsus usually forms a single row, or has one (or more) decentralized spinules; however, sometimes it can also end in two terminal spinules. Note that for *E. ossae*, Fet et al. (2013a) report this row as “*terminating distally with a single pair of stout spinules*”, see their fig. 43. However, specimens of *E. ossae* analyzed for this work show the same spinule pattern as *E. kinzelbachi* sp.n., i.e. usually a single row of spinules, or one (or more) decentralized spinules, or sometimes two terminal spinules.

#### Subgenus Incertae Sedis

*Euscorpius vignai* Tropea, Fet, Parmakelis, Kotsakiozi et Stathi, **sp. nov.**  
(Figs. 39–53; Table 1)

<http://zoobank.org/urn:lsid:zoobank.org:act:A0F50D-B6-5ED9-43C1-B4CD-7FA25E018444>

#### REFERENCES

- Euscorpius candiota* (in part: Karpathos): Menozzi, 1941: 235, 237.  
*Euscorpius carpathicus* (in part: Karpathos, Kasos): Kinzelbach, 1975: 33; Kinzelbach, 1982: 59–61.  
*Euscorpius carpathicus carpathicus* (in part: Karpathos): Kritscher, 1993: 384.  
*Euscorpius carpathicus* “Subgroup A3” (in part: Karpathos, Kasos): Fet, 2000: 53.  
*Euscorpius* sp. Clade E6 (in part: Karpathos): Parmakelis et al., 2013: 740.

**Type material** (10 specimens: 1 ♂, 9 ♀). **Holotype**: ♀, GREECE, *Dodekanese*: Karpathos Island, between Spoa and Olympos, 300 m, 29 March 1989, leg. A. Vigna (MZUR 78). **Paratypes**: GREECE, *Dodekanese*: Karpathos Island, Stes, 29 March 1989, leg. M. Galdieri,

1 ♀ (MZUR 77); Karpathos Island, Olympos, 24 March 1989, leg. A. Vigna, 1 ♀ (GTC 606); Karpathos Island, Olympos, 29 March 1989, leg. A. Vigna, 1 ♀ (MZUR 113); same data, 1 ♀ (GTC 607); Karpathos, Piles, primary school, 35.531687°N, 27.133392°E, 8 April 2000, leg. I. Stathi, 2 ♀ imm. (NHMC 1410, Eus65); Karpathos Island, Archangel Michael [Monastery, Lastos Plateau], 1000–1215 m, 4 May 1984, leg. P. Beron, 1 ♂ imm. (NHMNS 98). GREECE, *Dodekanese*: Kasos Island, above Ofri (=Fry), 30 March 1989, leg. M. Zapparoli, 1 ♀ (MZUR 76); same data, 1 ♀ (GTC 605).

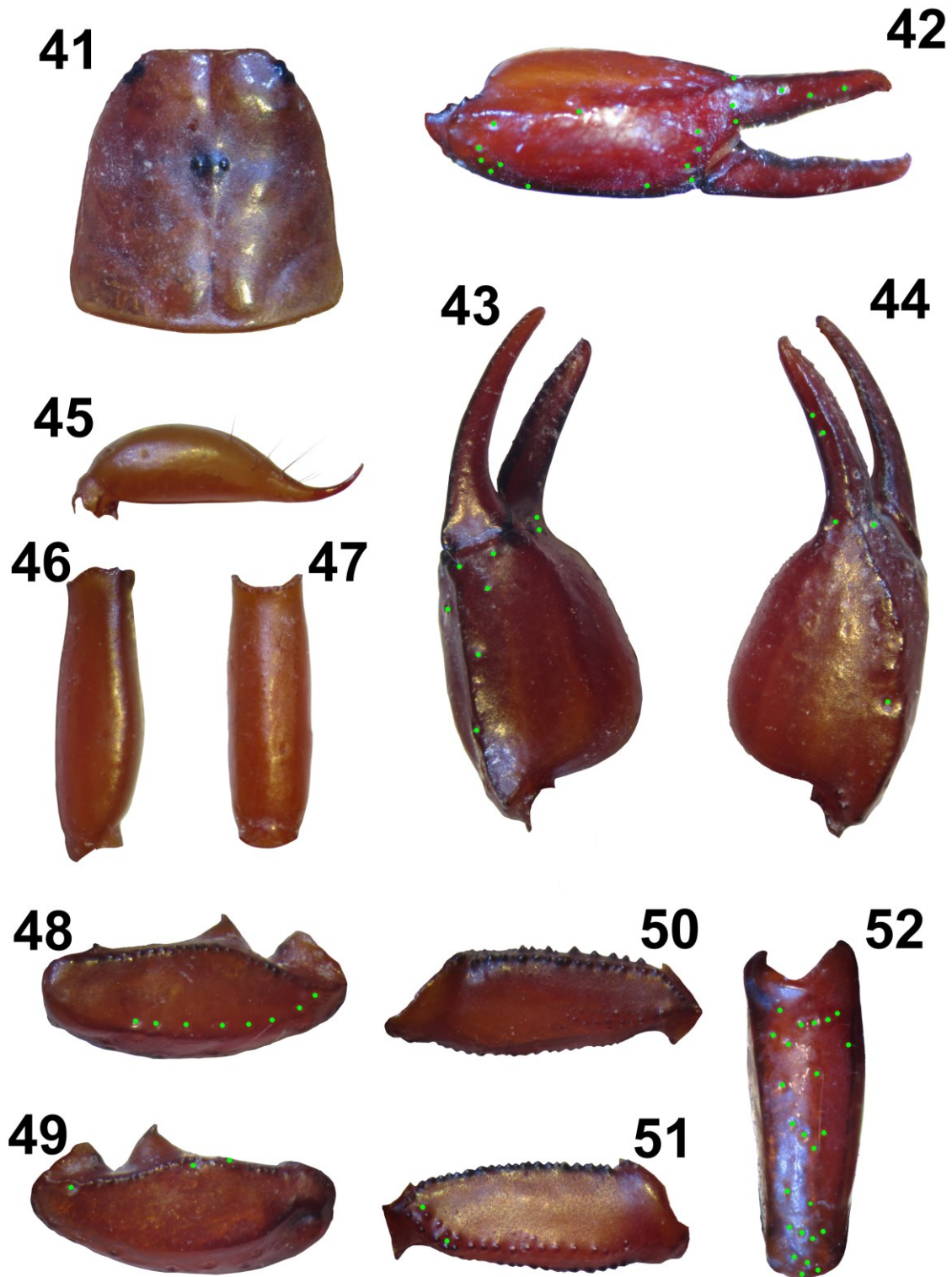
**Other material examined (not included in type series)** (10 specimens: 2 ♂, 6 ♀, 2 juv.): GREECE, *Dodekanese*: Karpathos Island, 1 ♀ (ZMB 15281); Karpathos Island, Menetes, Profitis Ilias, 528 m, 6 October 1977, leg. E. Kritscher, 2 ♀ (NHMW 15.989/1–2); Karpathos Island, Spoa, 14 October 1977, leg. E. Kritscher, 1 ♀ (NHMW 15.990); Karpathos Island, road along the coast, 2 April 1978, leg. E. Kritscher, 1 ♂ juv. (NHMW 15.991); Karpathos Island, Arkasa, Cape Paliokastro, Agia Sofia, 3 April 1978, leg. E. Kritscher, 1 ♀ juv. (NHMW 15.992); Karpathos Island, road Menetes–Aperi, 4 March 1987, leg. E. Kritscher, 1 ♀ juv. (NHMW 15.993); Karpathos Island, Agio Mesochori near Piles, pine forest, 450 m, Station 11, 8 April 2000, leg. A. Parmakelis & I. Stathi, 1 ♀, 2 juv. (NHMC 1411); Karpathos Island, Arkasa, 35.479307°N, 27.12022°E, 10 July 2005, leg. M. Colombo, 1 ♀ juv. (VFPC). GREECE, *Dodekanese*: Kasos Island, Stylokamara Cave, 6 May 1984, leg. P. Beron, 1 ♂ (NHMNS 96).

**DNA sequences** (Parmakelis et al., 2013: 740): GREECE, *Dodekanese*: Karpathos Island, Piles, primary school, 35.531687°N, 27.133392°E, 8 April 2000, leg. I. Stathi (NHMC 81.1.4, Eus65), E04, geneseq-2: 16S, COI, COII, ITS1 (GenBank accession numbers: KC215591, KC215674, KC215760, KC215845); Karpathos Island, Arkasa, 35.479307°N, 27.12022°E, 10 July 2005, leg. M. Colombo (VFPC), FESP16, geneseq-3: 16S, COI, COII, ITS1 (GenBank accession numbers: KC215649, KC215735, KC215820, KC215905)

**Geographic range**: Greece, *Dodekanese*, Karpathos and Kasos Islands (see map in Fig. 54).

**Etymology**: Named after the prominent Italian zoologist, Prof. Augusto Vigna Taglianti (Rome, Italy) who collected part of the type series of this new species.

**Diagnosis**: A small *Euscorpius* species, total length about 25–30 mm. Color of adults light brown-reddish, carapace and pedipalps can be darker reddish. No reticulations or marbling seen on carapace, metasoma and chelicerae. Particularly weakly granulated cuticle



**Figures 41–52:** *Euscorpius vignai* sp. n. **41.** Carapace. **42.** External view of the chela of adult female. **43.** Ventral view of the chela. **44.** Dorsal view of the chela. **45.** Telson of adult female. **46.** Lateral view of the metasomal segment V. **47.** Ventral view of the metasomal segment V. **48.** Ventral view of pedipalp patella. **49.** Dorsal view of pedipalp patella. **50.** Ventral view of pedipalp femur. **51.** Dorsal view of pedipalp femur. **52.** External view of pedipalp patella.





**Figure 53:** *Euscorpium vignai* sp. n., female holotype, ventral view of leg tarsus.

in overall body, especially the metasoma is particularly smooth or nearly completely smooth. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3} + Et_1$ ); the number of ventral trichobothria on the pedipalp patella usually is 8; the number of external trichobothria on pedipalp patella is:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 4$ ,  $est = 4$ ,  $et = 6$ . The pectinal teeth number is 9 in males and usually 7 in females. The telson vesicle in males is more swollen than in females.  $Lchel/Wchel$  ratio is 2.62 in females. Dorsal patellar spur well developed. Femur of pedipalp slightly shorter than patella or as long as it;  $Lfem/Lpat$  ratio is 0.98. Average ratio  $Lcar/Wcar$  is 1.03; average distance from center of median eyes to anterior margin of the carapace is 39.92 % of the carapace length. Average ratio of  $Lmet/Lcar$  is 2.336 in females.

**Trichobothrial and pectinal teeth count variation:**

The variation observed in 19 studied specimens (3 ♂, 16 ♀) is given below.

*Pectinal teeth in males:* 9/9 (3).

*Pectinal teeth in females:* 7/6 (1), 7/7 (13), 8/7 (1); in total, usually 7 (in 28, or 93.33 %); mean = 7.00, SD = 0.26 (n=30).

*Pedipalp patella trichobothria Pv:* 8/8 (17), ?/9 (1), 8/9 (1); in total, usually 8 (in 35, or 89.47 %); mean = 8.05, SD = 0.23 (n=37).

*Pedipalp patella trichobothria Pe:*  $et = ?/6$  (1), 6/5 (1), 6/6 (16), 6/7 (1), in total, usually 6 (in 35, or 89.47 %); mean = 6.00, SD = 0.24 (n=37);  $est = ?/4$  (1), 4/4 (9);  $em = ?/4$  (1), 4/4 (18);  $esb = ?/2$  (1), 2/2 (18);  $eb_a = ?/4$  (1), 4/4 (18);  $eb = ?/4$  (1), 4/4 (18).

**Description of the female holotype**

**Coloration:** Whole color light brown, with darker brown/reddish carapace and pedipalps; sternites, pec-

tines and genital operculum light brownish; chelicerae brown-orange.

**Carapace:** Length 4.02, posterior width 3.91; almost smooth, a hardly visible very fine and weak granulation on lateral surface is present; little deep anterior median, posterior lateral and posterior median furrows; two pairs of lateral eyes and two median eyes; distance from center of median eyes to anterior margin is 39.55% of carapace length; distance from center of median eyes to posterior margin is 60.45% of the carapace length.

**Mesosoma:** Tergites finely punctated and glossy; sternites very finely punctated. Spiracles small, oval shaped and inclined about 45° downward towards outside.

**Metasoma:** Almost completely smooth, just one or two very small, low and hardly visible granules on dorsal surfaces of segment II–IV; a few small, low, spaced and barely visible granules on ventrolateral carinae and just three small, low and barely visible granules on ventromedian carina of the segment V. The other carinae are lacking or obsolete. All intercarinal spaces are smooth.

**Telson:** Vesicle oblong/tapered, smooth, with ventral setae of different sizes, especially in surround of the vesicle/aculeus juncture; telson height 0.90; telson length 3.12; vesicle length 1.98; vesicle width 1.08;  $L/H$  ratio of the vesicle 2.2.

**Pectines:** Teeth number 7/7; middle lamellae number 4/4; several microsetae on marginal lamellae, middle lamellae and fulcra.

**Genital operculum:** Formed by two united chitinous plates.

**Sternum:** Pentagonal shape, type 2; length approximately equal to width, deep posterior emargination.

**Pedipalps:** Coxa and trochanter with tuberculated carinae. Femur: dorsal internal carinae tuberculated and dark; dorsal external carinae formed by tubercles slightly serrulated and spaced; external median carinae serrulated; anterior median formed by 8/9 conical tubercles, of which three bear a macroseta each; dorsal and ventral intercarinal spaces with very fine and uniform size granules. Patella: dorsal internal carinae with few marked tubercles; dorsal external carinae smooth, rounded, dark in distal half and obsolete in proximal half; ventral external carinae from smooth to rough with a few very low and spaced granules; ventral internal carinae granulated; dorsal intercarinal surface with scattered minute granules positioned in a non-uniform way; ventral intercarinal surface almost smooth with just very few minute granules near to ventral internal carinae. Dorsal patellar spur well-developed. Chela carina  $D1$  from smooth to rough with a few low and spaced granules;  $D4$  obsolete;  $V1$  is distinctly strong, dark and smooth with just three low granules proximally;  $V3$  rounded and with a few small and scattered granules; external intercarinal tegument smooth; inter-

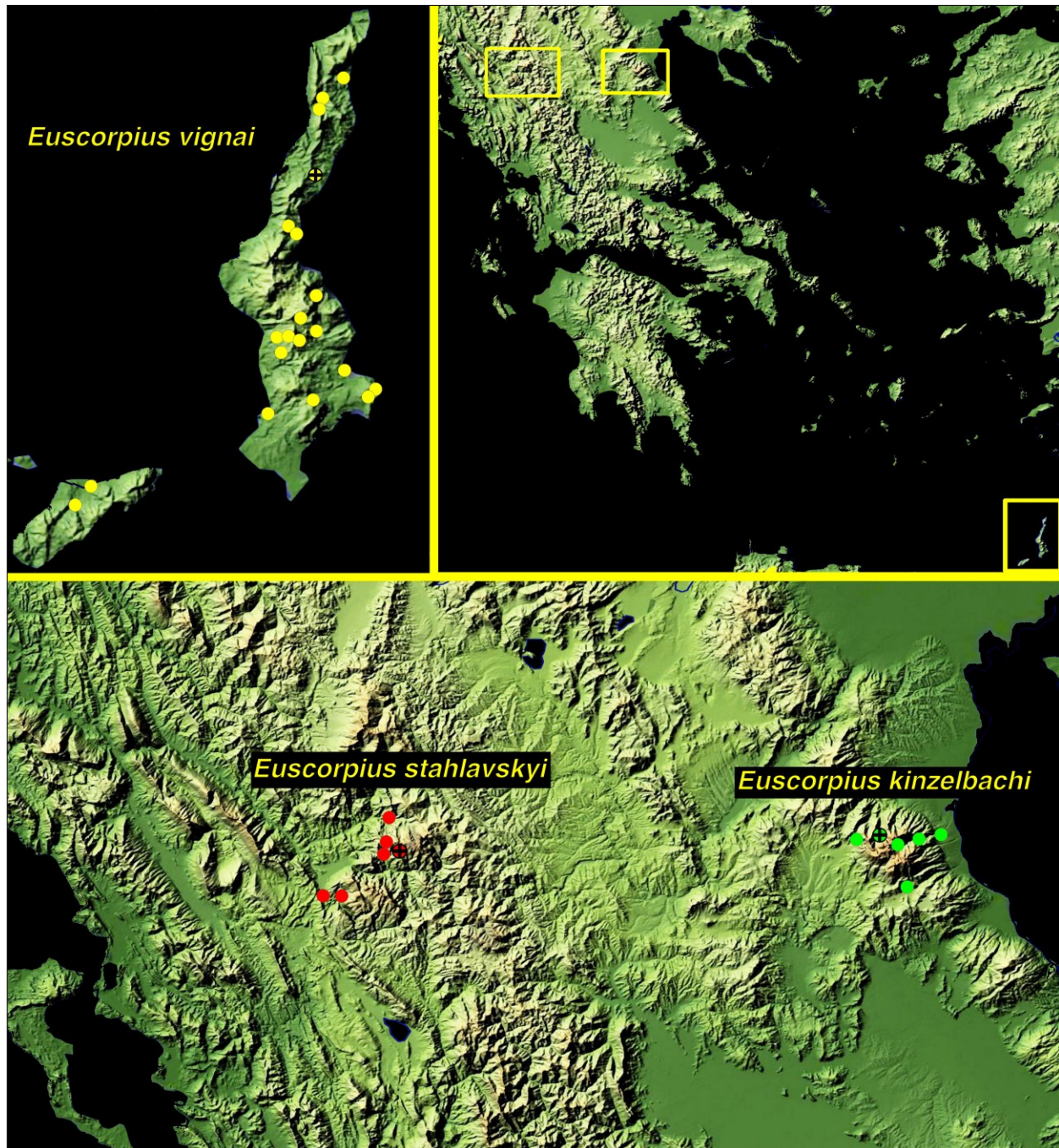


		<i>E. stahlavskyi</i> sp.n.		<i>E. kinzelbachi</i> sp.n.		<i>E. vignai</i> sp.n.
		<i>Holotype</i> ♂	<i>Paratype</i> ♀	<i>Holotype</i> ♂	<i>Paratype</i> ♀	<i>Holotype</i> ♀
Total	L	37.82	33.03	33.42	36.74	27.3
Carapace	L	5.34	5.04	5.04	5.58	4.02
	Posterior W	5.04	5.18	5.10	5.70	3.91
Metasoma	L	15.26	12.27	13.44	14.42	9.72
Segment I	L	1.98	1.65	1.68	1.80	1.26
	W	2.04	1.80	1.86	1.98	1.29
Segment II	L	2.34	1.92	2.10	2.22	1.50
	W	1.80	1.56	1.71	1.73	1.11
Segment III	L	2.70	2.16	2.37	2.51	1.68
	W	1.73	1.50	1.62	1.67	1.07
Segment IV	L	3.09	2.52	2.67	2.97	2.04
	W	1.65	1.44	1.50	1.56	1.02
Segment V	L	5.15	4.02	4.62	4.92	3.24
	W	1.68	1.49	1.56	1.62	1.02
Telson	L	5.34	4.44	4.92	4.80	3.12
Vesicle	L	4.14	2.94	3.54	3.18	1.98
	W	2.28	1.51	2.03	1.79	1.08
	H	2.49	1.50	2.04	1.74	0.90
Aculeus	L	1.20	1.50	1.38	1.62	1.14
Femur	L	4.65	4.14	4.35	4.92	3.57
	W	1.74	1.65	1.56	1.86	1.32
Patella	L	4.53	4.19	4.32	4.92	3.59
	W	1.98	1.80	1.74	1.98	1.44
Chela	L	9.42	8.76	8.82	9.72	7.20
	W-A	3.90	3.30	3.36	3.66	2.70
Movable Finger	L	5.40	5.04	4.97	5.58	3.84
Ratio	<i>CarA, CarP (%)</i>	41.01, 58.99	41.43, 58.57	41.66, 58.34	41.93, 58.07	39.55, 60.45
	<i>Lcar/Wcar</i>	1.059	0.973	0.988	0.979	1.027
	<i>Lcar/Lfer</i>	1.148	1.215	1.158	1.134	1.126
	<i>Lcar/Ltel</i>	1.000	1.135	1.024	1.162	1.288
	<i>Lchel/Wchel</i>	2.415	2.654	2.625	2.656	2.666
	<i>L/W met.seg I</i>	0.970	0.916	0.903	0.909	0.976
	<i>L/W met.seg II</i>	1.300	1.231	1.228	1.280	1.351
	<i>L/W met.seg III</i>	1.557	1.440	1.463	1.503	1.564
	<i>L/W met.seg IV</i>	1.872	1.750	1.780	1.904	2.000
	<i>L/W met.seg V</i>	3.064	2.691	2.961	3.037	3.176
	<i>Lmet/met.seg V</i>	2.964	3.052	2.909	2.930	3.000
	<i>Lmet/Lcar</i>	2.857	2.434	2.666	2.584	2.418
	<i>Lfem/Lpat</i>	1.026	0.988	1.007	1.000	0.995

**Table 1:** Measurements (mm) and morphometric ratios of *Euscorpium stahlavskyi* sp. n., *E. kinzelbachi* sp. n. and *E. vignai* sp. n. L, length; W, width; H, height; CarA, CarP %: average ratio of distances from center of median eyes to anterior and posterior margins of the carapace.

carinal tegument with very minute scattered granules. Typical chela finger dentition; *L/W* ratio of the chela 2.666; *Lfem/Lpat* ratio is 0.995.

**Trichobothria:** Chela: trichobothria on the pedipalp manus ventral surface 4/4 ( $V_{1-3}+Et_1$ ). Patella: ventral (*Pv*): 8/8; patella external (*Pe*): *et* = 6/6, *est* = 4/4, *em* =



**Figure 54:** Map showing type localities and known distribution of *Euscorpius stahlavskiyi* sp. n., *E. kinzelbachi* sp. n., and *E. vignai* sp. n. Type localities are indicated with an icon with a '+'. Map on upper right shows Greece proper and the island of Karpathos with the ranges of the three species indicated by yellow rectangles.

4/4,  $esb = 2/2$ ,  $eba = 4/4$ ,  $eb = 4/4$ . Femur: trichobothrium *d* on femur is slightly proximal to *i*, *e* distal to both, situated on dorsal external carina, but mostly on dorsal surface.

**Legs:** Legs with two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 7 to 8 stout spinules (including the ventral distal spinules pair) of

increasing size from proximal to distal; 3 flanking pairs of tarsal setae adjacent to the ventral spinules row. Ventral leg femora I–III with tubercles, dorsal leg femora I and IV sparsely granulated, II and III granulated.

**Chelicerae:** smooth, uniformly colored; movable finger: the dorsal distal denticle is smaller than the ven-

tral distal denticle; ventral edge is smooth with brush-like setae on the inner part; dorsal edge has five denticles: one large distal, two small subdistal (of which the distal is slightly larger), one large median, and a small basal; fixed finger has four denticles: one distal, one subdistal, one median and one basal; the median and the basal are in a fork arrangement; the internal surface has brush-like setae.

## Notes

1. *Euscorpium vignai* sp. n. is found on two Greek islands, Karpathos and Kasos, which are part of Dodekanese Islands, located in the eastern Aegean Sea between Crete, Cyclades, and the southwestern Anatolia. Crete is inhabited by *E. candiota* complex, which is considered to belong to the subgenus *Euscorpium* s.str. (Fet et al., 2013a). Populations inhabiting Cyclades Islands, currently under study, are part of *E. tauricus* complex. *E. avcii* Tropea et al., 2012, a species closely related to *E. tauricus*, is present in southwestern Anatolia (Dilek Peninsula) and on Samos Island (Greece). Another southwestern Anatolian species, *E. lycius* Yagmur et al., 2013, is now under further phylogenetic study.

Although *E. vignai* sp. n. is geographically closer to Crete, it is genetically divergent from the *E. candiota* clade, and also (together with the Rhodes population) forms a well-separated sister clade with *E. tauricus* + *E. avcii* (Parmakelis et al., 2013).

*E. candiota* mainly differs from *E. vignai* sp. n. in: (1) a higher *Pv* number, which is 9-10 versus 8 in *E. vignai* sp. n.; (2) a higher *Pe-et* number, mean 6.52 versus 6 in *E. vignai* sp. n.; (3) dorsal metasomal carinae being mostly granulated and ventral carinae on metasomal segment V well granulated in *E. candiota*, while *E. vignai* sp. n. has a particularly smooth or nearly completely smooth metasoma.

*E. avcii* differs from *E. vignai* sp. n. in: (1) a lower *Pv*, usually 7 versus 8 in *E. vignai* sp. n.; (2) lower *Pe-et*, usually 5 versus 6 in *E. vignai* sp. n.; (3) *DPS* being very poorly developed in *E. avcii*, while it is well-developed in *E. vignai* sp. n.

*E. lycius* mainly differs from *E. vignai* sp. n. in: (1) a higher *Pv*, which is 9 versus 8 in *E. vignai* sp. n.; (2) dorsal carinae of the metasomal segments I–IV and ventral carinae of metasomal segment V being granulated in *E. lycius* while *E. vignai* sp. n. has a particularly smooth or nearly completely smooth metasoma.

2. *E. vignai* sp. n. forms a sister group to the population from Rhodes Island (Parmakelis et al. 2013) (Fig. 55). Divergence between these two *Euscorpium* populations is relatively high. It is possible that Rhodes *Euscorpium* are a separate species but due to lack of specimens, in this paper we address only the populations

of Karpathos and Kasos. Note that these Dodekanese islands house two sister species of a scorpion genus *Protoiurus* Soleglad et al., 2012 (fam. Iuridae): *P. rhodiensis* Soleglad et al., 2012 on Rhodes and *P. stathiae* Soleglad et al., 2012 on Karpathos (Parmakelis et al., 2006a; Soleglad et al., 2012), which further indicates the divergence between the scorpions of these islands.

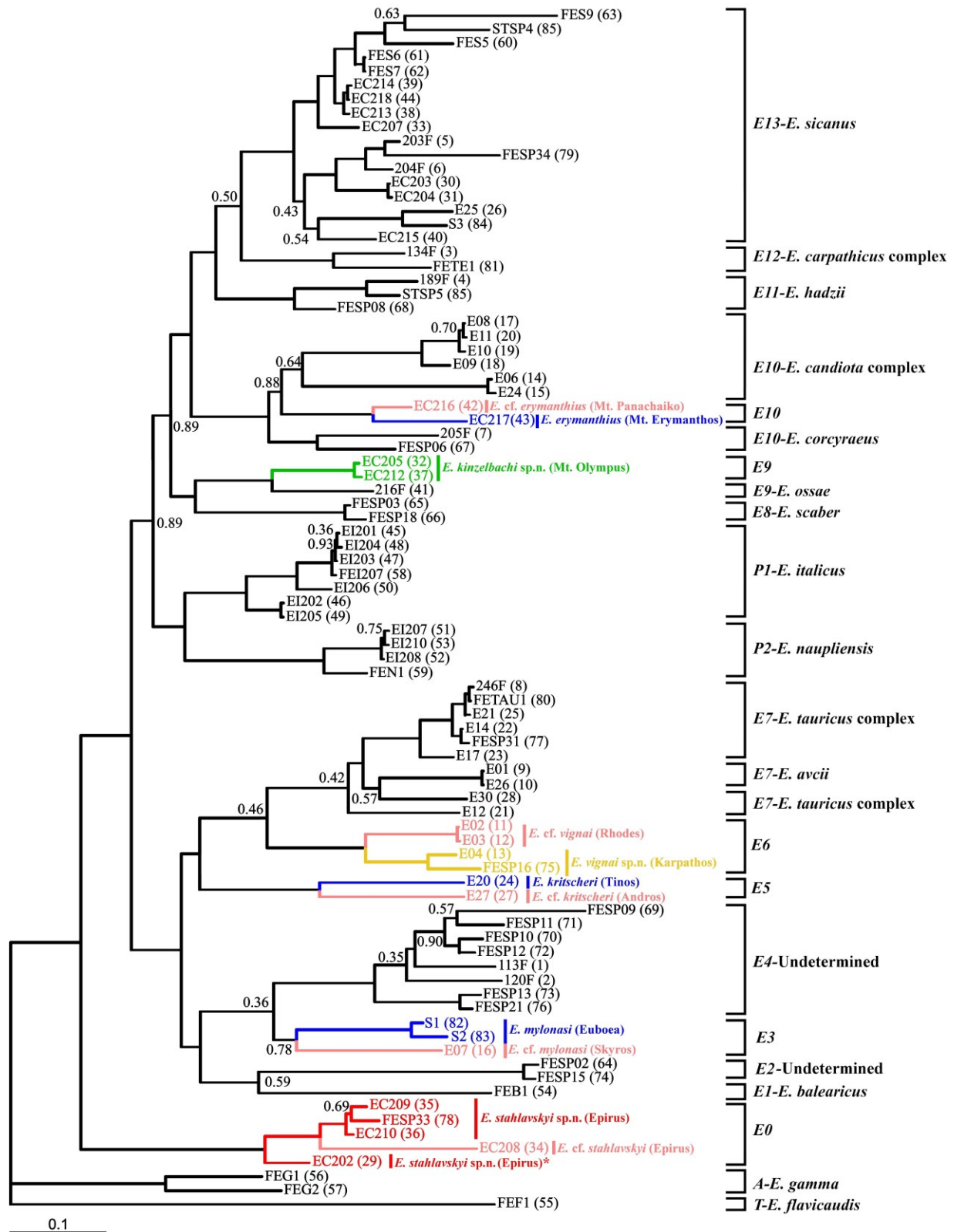
3. Menozzi (1941) was the first to record the presence of *Euscorpium* on the islands of Karpathos and Rhodes, which he identified as *E. candiota*. He examined 5 males and 18 females from these islands. The specimens from Karpathos were collected along Milli Creek, in Pigadia, Piles, and Olympos under stones. Menozzi (1941) reported some characters such as red-brick color, smooth appearance, *Pv* = 8 and *Dp* = 8 in males and 7 in females, which agrees with our data on *E. vignai* sp. n.

4. *Euscorpium sicanus* has been recorded from Kasos by Gasparo (2008, det. V. Vignoli). We concur with this record, in addition to the new species. A form of *E. sicanus* complex was also found on nearby Armathia Island as well as small islets off Armathia and Fournoi (Parmakelis et al., 2013). Other scorpion species found on Karpathos include *Protoiurus stathiae* (Iuridae) and *Mesobuthus gibbosus* (Brullé, 1832) (Buthidae) (Menozzi, 1941; Kinzelbach, 1975; Parmakelis et al., 2006b; Soleglad et al., 2012).

5. We have not been able to locate adult males of *E. vignai* sp. n.; therefore morphology of this species is incompletely known (e.g. males could be more granulated and have a different chela morphology and arrangement of trichobothria).

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**Figure 55:** A phylogenetic tree of *Euscorpium* based on multilocus DNA markers. After Parmakelis et al. (2013), amended with addition of new species described herein (red, *E. stahlavskiy* sp.n.; green, *E. kinzelbachi* sp.n.; yellow, *E. vignai* sp.n.); new species described by Fet et al. (2013b, 2014; *E. kritscheri*, *E. mylonasi*) and Tropea et al. (2013; *E. erymanthius*) (blue); and populations that require further study (pink). \*For EC202 position, see text for explanation.



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