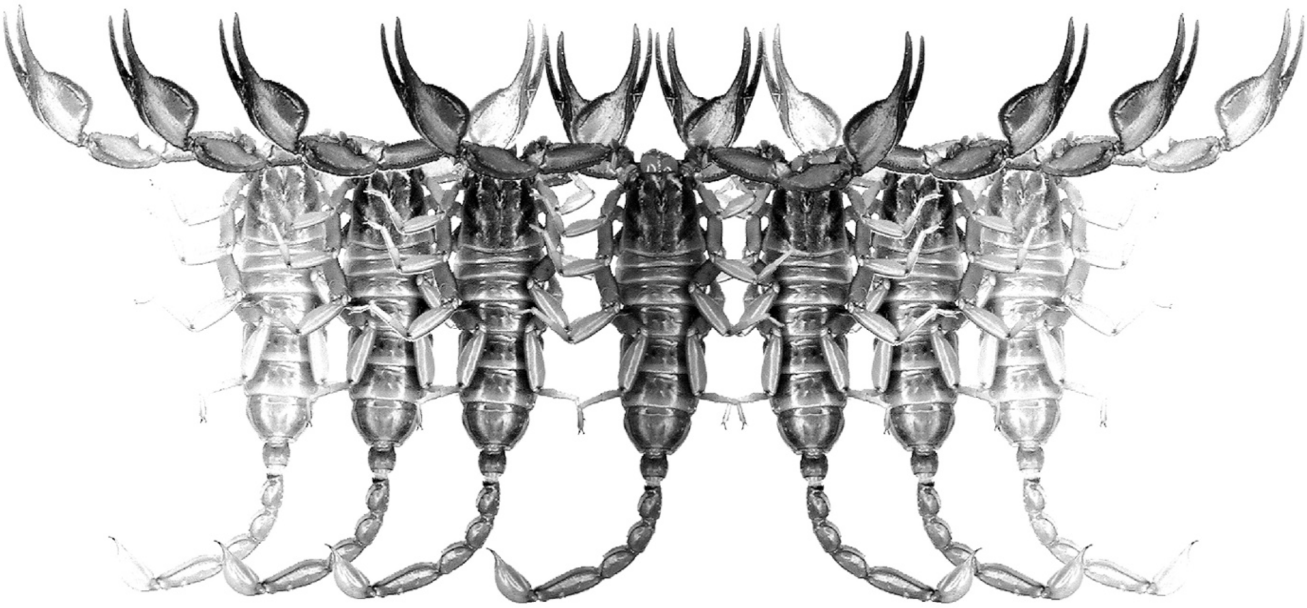
Euscorpius

Occasional Publications in Scorpiology



Euscorpius sulfur sp. n. (Scorpiones: Euscorpiidae), a new cave scorpion from Albania and northwestern Greece.

František Kovařík, Marek Audy, Serban M. Sarbu & Victor Fet

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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: https://mds.marshall.edu/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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Euscorpius — Occasional Publications in Scorpiology. 2023, No. 376

Euscorpius sulfur sp. n. (Scorpiones: Euscorpiidae), a new cave scorpion from Albania and northwestern Greece.

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Summary

A new species of cave scorpion, *Euscorpius sulfur* **sp. n.** (Scorpiones: Euscorpiidae) from Albania and northwestern Greece is described, fully complemented with color photographs of both live and preserved specimens, as well as their habitats.

Introduction

Our understanding of the scorpion genus *Euscorpius* Thorell, 1876, species of which are widespread in southern Europe and Anatolia, underwent a dramatic change in the last two decades. In Greece, for instance, this genus is currenty represented by 29 species (Fet et al., 2018; Kovařík & Šťáhlavský, 2020; Tropea et al., 2020, 2022) but the real diversity of Greek *Euscorpius* fauna is undoubtedly much higher as many taxa are still under revision.

Several species of *Euscorpius* have only recently been discovered in caves of the Balkan Penisula (Tropea, 2013; Fet et al., 2014; Tropea & Fet, 2015; Tropea & Ozimec, 2019, 2020; Karaman, 2020), including *Euscorpius aquilejensis* (C. L. Koch, 1837), *E. feti* Tropea, 2013, and *E. biokovensis* Tropea & Ozimec, 2020. Also, a remarkable eyeless *E. studentium* was recently described from a cave in Montenegro (Karaman, 2020).

In Greece, only two species, *E. birulai* Fet et al., 2014 (Euboea Island, Agia Triada Cave) and *E. giachinoi* Tropea & Fet, 2015 (Central Greece), have so far been identified as troglobitic. Here, we describe another new species of *Euscorpius* from Albania and northwestern Greece, which inhabits a unique sulfidic hypogene cave system (Audy et al., 2022).

Methods, Material & Abbreviations

Nomenclature and measurements follow Stahnke (1971), Soleglad & Sissom (2001), Kovařík (2009), Kovařík & Ojanguren Affilastro (2013), and Kovařík & Šťáhlavský (2020) except for trichobothriotaxy (Vachon, 1974).

Specimen Depository: FKCP (František Kovařík, private collection; will be merged in future with the collections of the National Museum of Natural History, Prague, Czech Republic).
Morphometrics: D, depth; L, length; W, width. *Pedipalp finger dentition*: MD, median denticles; ID, inner denticles; IAD, inner accessory denticles; OD, outer denticles.

Systematics

Family Euscorpiidae Laurie, 1896
Euscorpius Thorell, 1876
(Figures 1–50, Table 1)
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Euscorpius Thorell, 1876: 15; Fet & Sissom, 2000: 357–377 (in part, complete reference list until 1998); Kovařík & Šťáhlavský, 2020: 1–37, figs. 1–186, tabs. 1–4; Kovařík et al., 2020: 1–17, figs 1–61, tabs. 1–2; Tropea et al., 2020: 185–197, figs. 1–24, tabs. I–IV; Podnar et al., 2021: 1–26, figs. 1–9.

TYPE SPECIES. *Scorpio carpathicus* Linnaeus, 1767

DIAGNOSIS. Total length 20–50 mm. Movable fingers of pedipalp chela with MD aligned in a single straight row along entire length of chela fingers; ID, IAD (5 in number) and OD present. OD are displaced to outer aspect of fingers. Pedipalp chela flat in appearance. Trichobothrial pattern type C. Two subdistal denticles present on cheliceral movable finger dorsal edge. Ventral edge of cheliceral movable finger smooth; serrula

Figures 1–**2**: *Euscorpius sulfur* **sp**. **n**., females paratopotypes in vivo habitus under UV (1, photograph by Ruxandra Nitescu) and white (2, photograph by Traian Brad) light.

Dimensions (mm)		*Euscorpius sulfur* sp. n. ♂ holotype	*Euscorpius sulfur* sp. n. ♀ paratopotype
Carapace	L / W	4.43 / 4.55	5.01 / 4.80
Mesosoma	L	9.76	13.00
Tergite VII	L / W	1.64 / 3.32	2.47 / 4.07
Metasoma + telson	L	16.33	16.20
Segment I	L / W / D	1.64 / 1.55 / 1.39	1.71 / 1.61 / 1.27
Segment II	L / W / D	1.93 / 1.39 / 1.34	1.94 / 1.35 / 1.25
Segment III	L / W / D	2.16 / 1.27 / 1.29	2.08 / 1.29 / 1.30
Segment IV	L / W / D	2.40 / 1.15 / 1.25	2.36 / 1.15 / 1.17
Segment V	L / W / D	3.86 / 1.20 / 1.30	4.04 / 1.13 / 1.19
Telson	L / W / D	4.34 / 1.56 / 1.82	4.07 / 1.28 / 1.20
Pedipalp	L	15.30	17.05
Femur	L / W	3.61 / 1.51	4.16 / 1.67
Patella	L / W	3.78 / 1.66	4.32 / 1.83
Chela	L	7.91	8.57
Manus	W / D	3.28 / 2.17	3.22 / 2.18
Movable finger	L	4.46	4.69
Total	**L**	**30.52**	**34.21**

Table 1. Comparative measurements of types of *Euscorpius sulfur* **sp. n**. Abbreviations: length (L), width (W, in carapace it corresponds to posterior width), depth (D).

absent. Two pedal spurs present on legs. Tarsal spurs on legs absent. Sternum pentagonal in shape. Hemispermatophore lamelliform in shape with broad trunk and distal lamina. Telson without subaculear tubercle. Metasoma I–IV with single median carina usually absent.

Euscorpius sulfur sp. n.

(Figures 1–53, Table 1)

http://zoobank.org/urn:lsid:zoobank.org:act:41899163-DAA2-437A-863E-269E425130D5

Type locality and type repository. **Albania**, Sarandaporo Valley, Vromoner Canyon, Sulfur Cave, 40°05'46.06"N 20°40'44.00"E (40.083333°N 20.666667°E); FKCP.

Type material. **Albania**, Sarandaporo Valley, Vromoner Canyon, Sulfur Cave, 40°05'46.06"N 20°40'44.00"E (40.083333°N 20.666667°E, Figs. 51 and 53), 1♂ (holotype) 3♂5♀1juv. ♀ (paratopotypes) and Turtle Cave, 40°05'53.59"N 20°40'33.86"E, 1juv.♂1juv.♀ (paratypes, Figs. 42–49), 3–4 May and 9 June 2023, leg. M. Audy, S. M. Sarbu, T. Brad & M. Kenesz.

Etymology. Named after the Sulfur Cave, the type locality, to indicate an exceptional habitat of the new species.

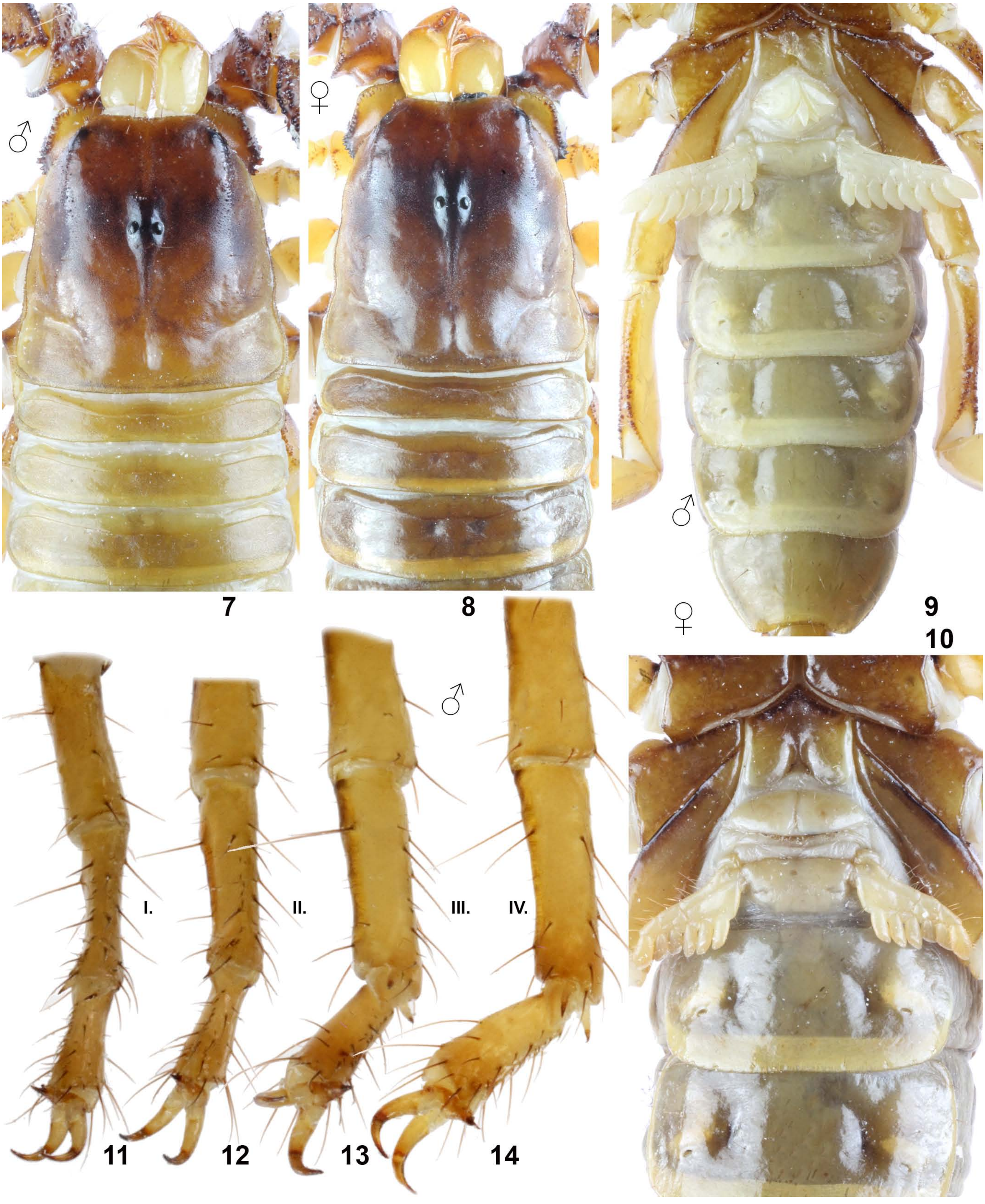
Diagnosis (♂♀). Total length 28–35 mm. Color reddish yellow to brown, telson yellow. Pedipalp patella external trichobothria numbers: 4*eb*, 4eb_a, 2*esb*, 4*em*, 4*est*, 5–6*et*, ventral aspect of patella with 8 trichobothria. Pectinal teeth number 6–8 in males, 6–7 in females. Chelicerae yellow without reticulation. Male with pedipalp finger marginal profile type C (Kovařík & Šťáhlavský, 2020: 2), female with fingers undulate. Dorsal metasomal carinae on segments I– IV irregularly granulated, mainly in male. Ventrolateral carinae on metasomal segments II–IV present and smooth. Metasoma V ventrally with median carina present. Metasoma finely granulated dorsally in male and smooth in female. Chela length/width ratio, 2.38–2.41 in male, 2.60–270 in female. Metasoma IV length/width ratio, 2.0–2.1 in both sexes. Telson length/depth ratio, 2.3–2.5 in male, 3.3–3.5 in female.

Description (♀♂). Total length 28–35 mm in both sexes. The habitus is shown in Figs. 2–6. For position and distribution of trichobothria on pedipalps, see Figs. 33–38. For sexual dimorphism, see below in the description. For measurements, see Table 1.

Coloration (Figs. 2–6). Base color uniformly reddish yellow to brown including sternites, telson yellow, pedipalps reddish brown. Chelicerae yellow without reticulation.

Carapace and mesosoma (Figs. 7–10). Carapace very finely granulated with several smooth areas; carinae absent. Anterior margin of carapace slightly concave. Carapace with two lateral eyes. Tergites very finely granulated, more so in male, without carinae developed. Tergite VII lacking median and paired lateral carinae. Sternites III–VII smooth and lustrous; VII lacking median and paired lateral carinae. Stigmata small, narrow ellipical. Pectinal teeth number 6–8 (1 x 6, 2 x 7, 9 x 8) in males and 6–7 (9 x 6, 5 x 7) in females, fulcra present. Pectines with 3 marginal lamellae and 5–6 middle lamellae.

Figures 3–6: *Euscorpius sulfur* **sp**. **n**. **Figures 3–4**. Male holotype in dorsal (3) and ventral (4) views. **Figures 5–6**. Female paratopotype in dorsal (5) and ventral (6) views. Scale bars: 10 mm.



Figures 7–14: *E. sulfur* **sp. n. Figures 7**, **9**, **11–14**. Male holotype, carapace and tergites I–III (7), coxosternal area and sternites (9), left legs I–IV, retrolateral aspect (11–14 respectively). **Figures 8**, **10**. Female paratopotype, carapace and tergites I–III (8), coxosternal area and sternites III–IV (10).

Figures 15–22: *E. sulfur* **sp**. **n**. **Figures 15**. Male paratype, telson lateral. **Figures 17–19**. Male holotype, metasoma and telson lateral (17), dorsal (18), and ventral with sternite VII (19) views. **Figures 16**, **20–22**. Female paratopotype, telson lateral (16), metasoma and telson lateral (20), dorsal (21), and ventral (22) views. Scale bars: 10 mm (17–22).

Figures 23–32. *E. sulfur* **sp. n.**, male holotype, pedipalp segments. Chela dorsal (23), external (24) and ventral (25) views. Patella dorsal (26), external (27) and ventral (28) views. Trochanter and femur dorsal (29) and ventral (30) views. Movable (31) and fixed (32) finger dentition.

Metasoma and telson (Figs. 15–22). Metasoma sparsely hirsute. Metasoma I–V very finely granulated in male, several fine granules also present on lateral surfaces of metasoma I and V in both sexes. Dorsal carinae on metasomal segments I–V irregularly granulated in both sexes, more in males; dorsolateral carinae absent; ventrolateral carinae present or indicated and smooth on segments I–IV, granulated on segment V. Metasoma V ventrally granulated with median carina present, metasoma I–IV with ventral median carinae absent. Anal arch with small pigmented granules. Telson rather smooth, elongate in female and swollen in male, with annular ring indicated in both sexes. Aculeus short, more curved in male.

Pedipalps (Figs. 23–49). Pedipalps very sparsely hirsute. Patella with 23–24 (4*eb*, 4eb_a, 2*esb*, 4*em*, 4*est*, 5–6*et*) external and 8 ventral trichobothria. Chela with 4 trichobothria in ventral series, of which V_4 is located external to the ventroexternal carina, on the external surface near Eb_1. Entire femur finely granulated, strongly ventrally and patella fine granulated irregularly. Femur with granulated developed carinae;

Figures 33–41. *E. sulfur* **sp**. **n**., female paratopotype, pedipalp segments. Chela dorsal (33), external (34) and ventral (35) views. Patella dorsal (36), external (37) and ventral (38) views. Trochanter and femur dorsal (39) and ventral (40) views. Movable finger dentition (41) Trichobothrial pattern is indicated by white circles (33–39).

Figures 42–49. *E. sulfur* **sp. n.**, female juvenile paratype from Turtle Cave, pedipalp segments. Chela dorsal (42), external (43) and ventral (44) views. Patella dorsal (45), external (46) and ventral (47) views. Trochanter and femur dorsal (48) and ventral (49) views.

ventroexternal carina incomplete. Patella with 5 complete carinae including irregular wide externomedian carina. Dorsal patella spur well developed in both sexes. Entire manus with fine, rounded granules, which do not form a median carina; only five chelal carinae developed. Male with pedipalp finger undulation profile type C, female with fingers undulate.
Legs (Figs. 11–14). Both pedal spurs present on all legs, lacking spinelets; tibial spurs absent. Tarsus with single row of spinules on ventral surface, terminating distally with two essentially adjacent spinules.

Affinities. *Euscorpius sulfur* **sp**. **n**. is morphologically most similar to *E. candiota* Birula, 1903 from Greece (Crete), which differs by having ventral aspect of pedipalp patella with 9–10 trichobothria (8 in *E. sulfur* **sp**. **n**.).

Geographically the closest cave species, *E. biokovensis* Tropea & Ozimec, 2020 described from caves from Croatia and Bosnia-Herzegovina differs by having metasoma V ventral with median carina obsolete to absent and male with pedipalp finger marginal profile type B (type C in *E. sulfur* **sp**. **n**., see Kovařík & Šťáhlavský, 2020: 2).

Some other species described recently from the region differ in having 5–6 trichobothria in *eb* series on pedipalp patella external (*E. bonacinai* Kovařík & Šťáhlavský, 2020 from Albania or *E. kabateki* Kovařík & Šťáhlavský, 2020 from Greece). *E. janstai* Kovařík & Šťáhlavský, 2020 from North Macedonia differs by darker colored telson and legs and male with pedipalp finger marginal profile type A (type C in *E. sulfur* **sp**. **n**., see Kovařík & Šťáhlavský, 2020: 2).

Distribution. Sulfidic caves in the Vromoner Canyon, Sarandaporo Valley, on the border between Albania and Greece (Figs. 50–53). The majority of specimens were observed within the Albanian territory; the entrance to the Sulfur Cave lies on the Greek side of the border.

Ecology

River Sarandaporo (Σαραντάπορος) originates in Greece and has a catchment area of 850 km^2. Where the river crosses Greece/Albanian border, it cuts a narrow and short gorge in limestones rising from Flysch deposits, which form a low permeable cup. This gorge is called Vromoner (which means “bad smell” in Greek). A 100 km long fault that crosses Albania from north to south intersects Sarandaporo Valley in this location, allowing the deep fluids to rise along the fault to emerge through warm (26°C) sulfidic springs located in the riverbed, on the river banks and inside hypogenic caves, creating a unique geomorphological phenomenon. The remarkable sulfidic hypogene caves in the Vromoner thermal springs area were recently investigated by Audy et al., in 2022. The most massive caves are Turtle Cave (Shpella Breshkë) and Atmos Cave (both located in Albania), Sulfur Cave (located right on the border between the two countries with its entrance in Greece and the majority of the cave passages located in Albania), and the Pixaria and Swallow Caves (located in Greece, a few km to the east). Maximum air temperature in these caves reaches 29°C. The South Albanian fault with rising warm sulfidic waters, follows the line of the Tomor–Qeshibesh–Bodar–Lëngaricë–Postenan–Melesin–Vromoner (Eftimi & Frashëri, 2016). Hypogene caves are likely to be present in several areas in southern Albania where this fault crosses the surface limestone outcroppings.

Biological communities inhabiting sulfidic caves are unusually abundant and diverse, and many of these caves are considered hotspots for subterranean biodiversity (Brad et al., 2021; Popa et al., 2018). The food base in these hypogean ecosystems is produced *in situ* chemoautotrophically by sulfur-oxidizing microorganisms (Sarbu et al., 1996). The cave microbiomes feed the aquatic and terrestrial detritivore species which in turn represent the trophic resources for the numerous predators in the caves’ food webs. The submerged sediments as well as the walls in the sulfidic caves in the Vromoner gorge are host to rich communities of sulfide-oxidizing microorganisms. The white submerged filamentous microbial biofilms feed a dense population of larvae of scirtid beetles and chironomid flies. Their adults emerge from the water and are preyed upon by a large number of predators (agelenid spiders, lithobiid centipedes, and scorpions). On the other hand, the microbial biofilms covering the cave walls are grazed upon by dense populations of collembola and terrestrial isopods which in turn feed numerous small spiders, centipedes, and pseudoscorpions. In the “Zoological Garden” section of Sulfur Cave, as well as on the banks of the sulfidic stream in Turtle Cave, juvenile and adult specimens of *Euscorpius sulfur* were observed feeding on chironomid flies, spiders, and centipedes. Alternately, in the deep section of Sulfur Cave near the “Blue Eye” spring, scirtid larvae, pupae and adults cover the sediments along the banks of the sulfidic stream and are preyed upon by a dense population of *E. sulfur* of up to five specimens per m^2. This suggests that the chemoautotrophic sulfur-oxidizing microorganisms generate copious amounts of trophic resources that can support the unusually large number of predators inhabiting these caves.

The ecological niche of *Euscorpius sulfur* can be compared to that of a remarkable scorpion *Akrav israchanani* Levy, 2007 (Akravidae) in the Ayyalon Cave in Israel, another closed, chemoautotrophically based subterranean ecosystem (Levy, 2007; Por, 2007; Fet et al., 2011, 2017). In the Ayyalon, energy and biomass come solely from chemoautotrophic sulfide-oxidizing, mat-forming bacteria *Beggiatoa* sp. found in a sulfidic underground pool (Por, 2007). These bacteria nourish a variety of Protozoa; the pool also contains a burgeoning stygobiontic crustacean fauna (Por, 2007). The relict, blind scorpion species (known only from dry remains of ca. 20 individuals; no live specimens have been found!) presumably was feeding on those aquatic crustaceans (Fet et al., 2011).

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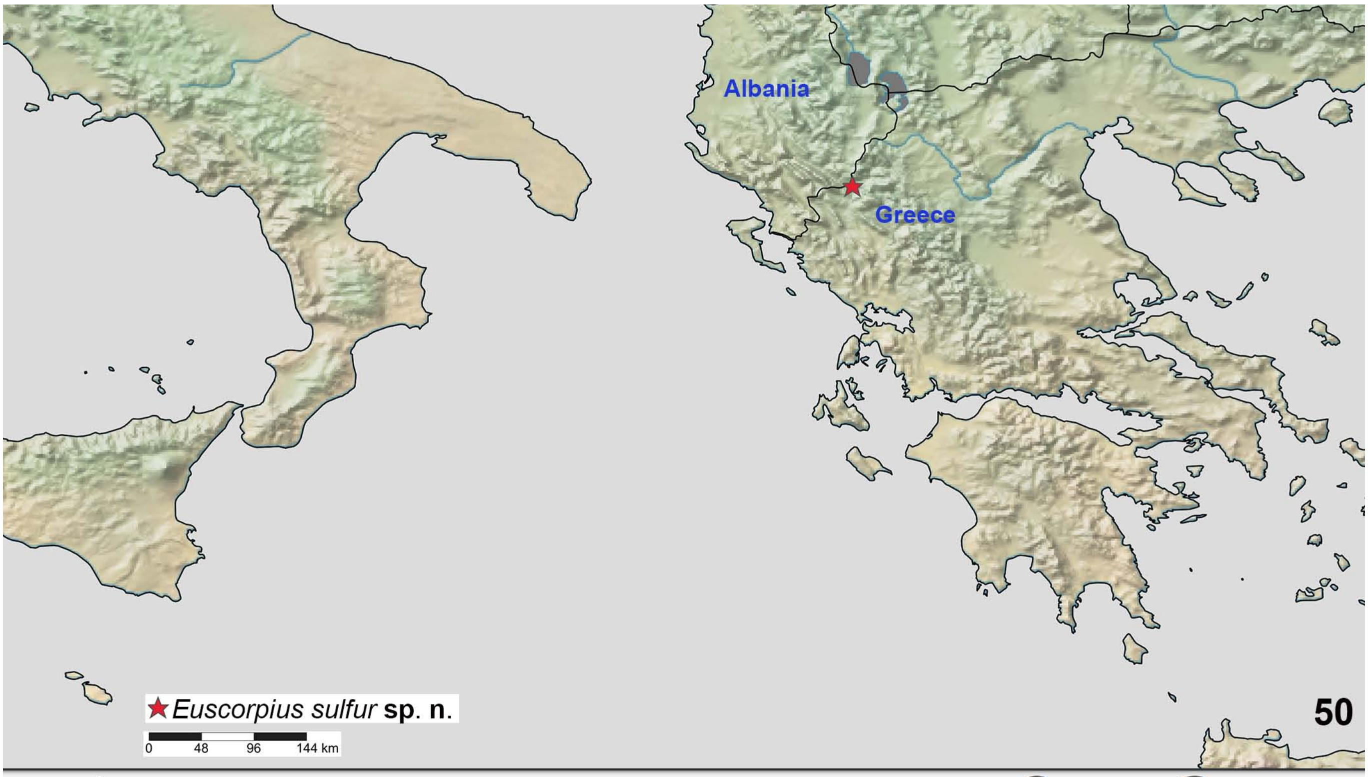
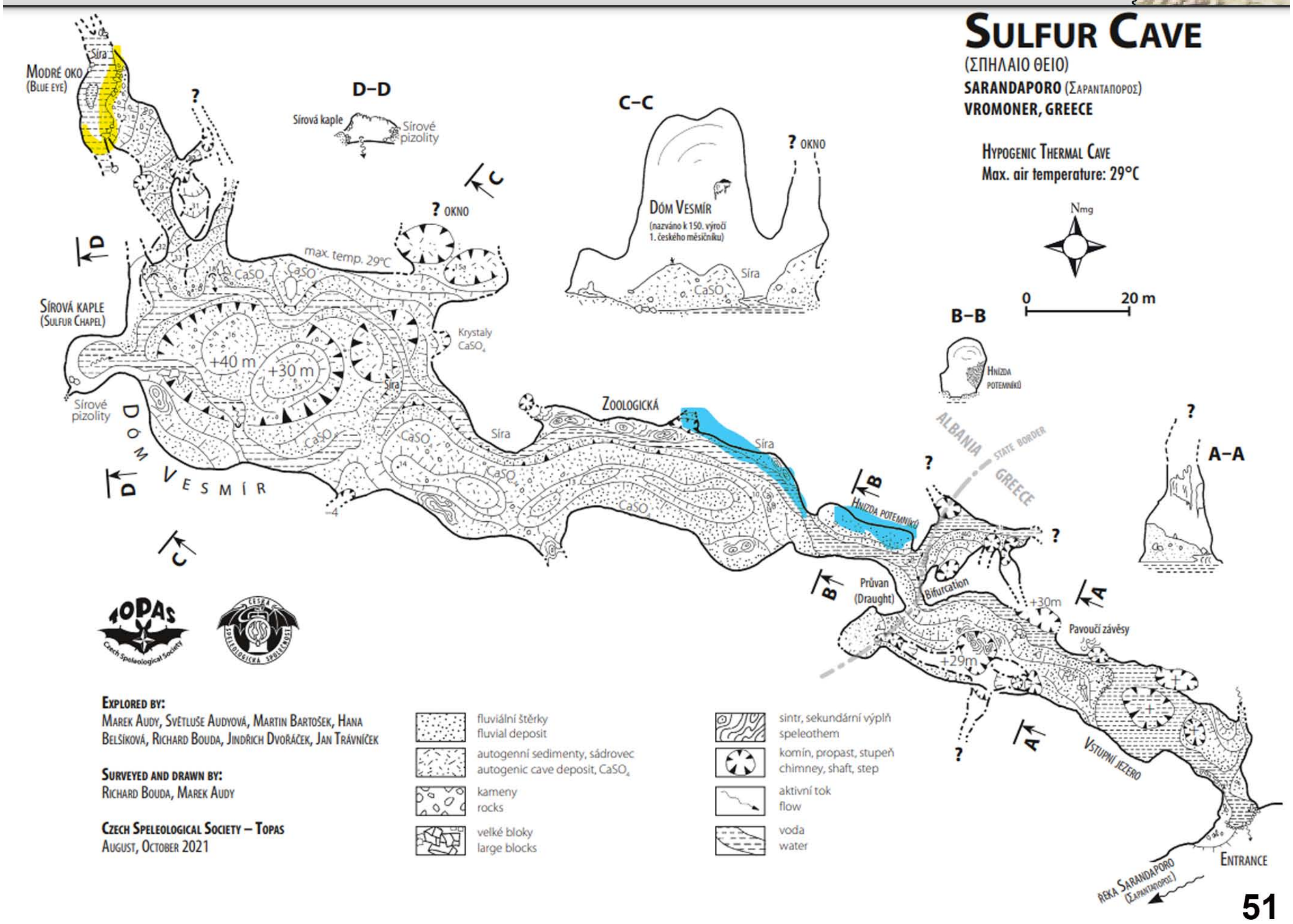
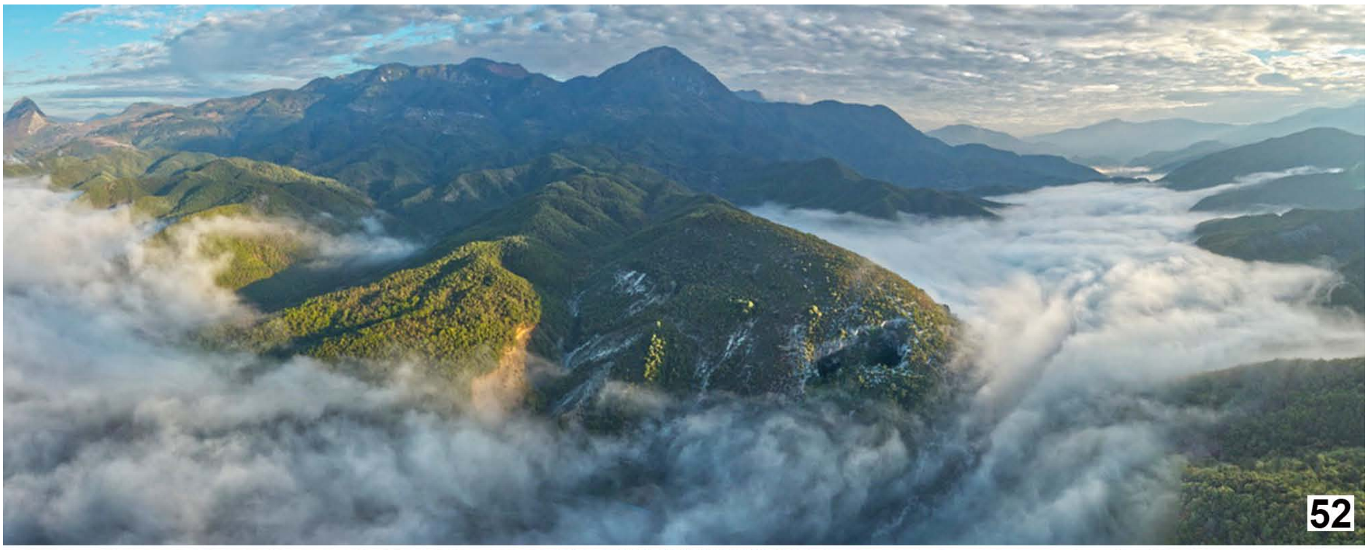




Figures 50–51. **Figure 50**. Map of distribution of *E. sulfur* **sp**. **n**. **Figure 51**. A map of Sulfur Cave. Surveyes by M. Audy, R. Bouda, drawn by M. Audy (Czech Speleological S ociety 2021).



Figures 52–53. **Figure 52**. The Sarandaporo Valley at the border between Albania and Greece. The massive Vromoner hypogene sinkhole, visible on the limestone hill in the foreground, communicates through vertical chimneys with Sulfur Cave. Photograph by M. Audy. **Figure 53**. The spacious Vesmír (Universe) Dome, situated under the sinkhole (in Figure 51). Several hydrogene sulfide-rich thermal springs (26°C) are located on the passage floor under the dome. The gypsum accumulations are covered with sulfur. Photograph by M. Audy & R. Bouda.

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References

AUDY, M., R. BOUDA, J. BRUTHANS & V. RUŽIČKA. 2022. Albanian hypogene caves in the area of Vromoner thermal springs on the Sarandoporo River. *Speleoforum*, 41: 41–51.

BRAD, T., S. IEPURE & S. M. SARBU. 2021. The chemoautotrophically based Movile Cave groundwater ecosystem, a hotspot of subterranean biodiversity. *Diversity*, 13: 128. doi:10.3390/d13030128

EFTIMI, R. & A. FRASHËRI. 2016. *Ujërat Termale dhe minerale të Shqipërisë.* Tirana, 224 pp.

FET, V., A. PARMAKELIS, I. STATHI, G. TROPEA, P. KOTSAKIOZI, L. KARDAKI & M. NIKOLAKAKIS. 2018. Fauna and zoogeography of scorpions in Greece. Pp. 123–134 *In*: Sfenthourakis, S., P. Pafilis, A. Parmakelis, N. Poulakakis & K. A. Triantis (eds.) *Biogeography and Biodiversity of the Aegean*. In honour of Prof. Moysis Mylonas. Broken Hill Publishers Ltd, Nicosia, Cyprus.

FET, V. & W. D. SISSOM. 2000. Family Euscorpiidae. Pp. 355–381. *In:* Fet, V., W. D. Sissom, G. Lowe & M. E. Braunwalder (eds.) *Catalog of the Scorpions of the World (1758-1998).* New York: New York Entomological Society, 690 pp.

FET, V., M. E. SOLEGLAD, A. PARMAKELIS, P. KOTSAKIOZI & I. STATHI. 2014. Two new species of *Euscorpius* (Scorpiones: Euscorpiidae) from Euboea Island, Greece. *Arthropoda Selecta*, 23(2): 111–126.

FET, V., M. E. SOLEGLAD & S. L. ZONSTEIN. 2011. The genus *Akrav* Levy, 2007 (Scorpiones: Akravidae) revisited. *Euscorpius*, 134: 1–49.

FET, V., M. E. SOLEGLAD, S. L. ZONSTEIN, I. NAAMAN, S. LUBATON, B. LANGFORD & A. FRUMKIN. 2017. The second record of a relict *Akrav israchanani* Levy, 2007 (Scorpiones: Akravidae) from Levana Cave, Israel. *Euscorpius*, 247: 1–12.

KARAMAN, I. 2020. A new *Euscorpius* species (Scorpiones: Euscorpiidae) from a Dinaric cave – the first record of troglobite scorpion in European fauna. *Biologia Serbica*, 42(1): 14–31.

KOVAŘÍK, F. 2009. *Illustrated catalog of scorpions. Part I. Introductory remarks; keys to families and genera; subfamily Scorpioninae with keys to* Heterometrus *and Pandinus species.* Prague: Clairon Production, 170 pp.

KOVAŘÍK F., G. LOWE, M. BYRONOVÁ & F. ŠŤÁHLAVSKÝ. 2020. *Euscorpius thracicus* sp. n. (Scorpiones: Euscorpiidae) from Bulgaria. *Euscorpius*, 326: 1–17.

KOVAŘÍK, F. & A. A. OJANGUREN AFFILASTRO. 2013. *Illustrated catalog of scorpions. Part II. Bothriuridae; Chaerilidae; Buthidae I. Genera* Compsobuthus, Hottentotta, Isometrus, Lychas, *and* Sassanidotus. Prague: Clairon Production, 400 pp.

KOVAŘÍK, F. & F. ŠŤÁHLAVSKÝ. 2020. Five new species of *Euscorpius* Thorell, 1876 (Scorpiones: Euscorpiidae) from Albania, Greece, North Macedonia, and Serbia. *Euscorpius*, 315: 1–37.

LEVY, G. 2007. The first troglobite scorpion from Israel and a new chactoid family (Arachnida: Scorpiones). *Zoology of the Middle East*, 40: 91–96.

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 (eds.). *Scorpions 2001. In Memoriam Gary A. Polis.* Burnham Beeches, Bucks: British Arachnological Society.

PODNAR M., I. GRBAC, N. TVRTKOVIČ, C. HÖRWEG & E. HARING. 2021. Hidden diversity, ancient divergences, and tentative Pleistocene microrefugia of European scorpions (Euscorpiidae: Euscorpiinae) in the eastern Adriatic region. *Journal of Zoological Systematics and Evolutionary Research*, 59: 1–26. doi:10.1111/jzs.12562

POPA, I., T. BRAD, M. VAXEVANOPOULOS, A. GIURGINCA, S. C. BABA, S. IEPURE, R. PLĂIAŞU & S. M. SARBU. 2019. Rich and diverse subterranean invertebrate communities inhabiting Melissotrypa Cave in Central Greece. *Travaux de l'Institute de Spéologie "Émile Racovitza"*, 58: 65–78.

POR, F. D. 2007. Ophel: a groundwater biome based on chemoautotrophic resources. *The Hydrobiologia*, 592: 1–10.

SARBU, S. M., T. C. KANE & B. K. KINKLE. 1996. A chemoautotrophically based groundwater ecosystem, *Science*, 272: 1953–1955. doi:10.1126/science.272.5270.1953

STAHNKE, H. L. 1971. Scorpion nomenclature and mensuration. *Entomological News*, 81: 297–316.

THORELL, T. 1876. On the classification of scorpions. *Annals and Magazine of Natural History*, 4(17): 1–15.

TROPEA, G. 2013. A new species of *Euscorpius* Thorell, 1876 from the western Balkans (Scorpiones: Euscorpiidae). *Euscorpius*, 174: 1–10.

TROPEA, G. & V. FET. 2015. Two new *Euscorpius* species from central-western Greece (Scorpiones: Euscorpiidae). *Euscorpius*, 199: 1–16.

TROPEA, G., V. FET, A. PARMAKELIS, P. KOTSAKIOZI, I. STATHI & S. ZAFEIRIOU. 2020. *Euscorpius lesbiacus* sp. n., a new species of scorpion from Lesvos Island, Greece (Scorpiones: Euscorpiidae). *Revista Ibérica de Aracnologia*, 37: 185–195.

TROPEA, G., V. FET, A. PARMAKELIS & I. STATHI. 2022. Two new species of *Euscorpius* (Scorpiones, Euscorpiidae) from Skyros and Andros Islands, Greece. *Zoodiversity* (Kyiv), 56(4): 307–322.

TROPEA, G. & R. OZIMEC. 2019. Description of the adult male of *Euscorpius feti* Tropea, 2013 (Scorpiones: Euscorpiidae), with notes on cave ecology of this species. *Euscorpius*, 291: 1–10.

TROPEA, G. & R. OZIMEC. 2020. Another new species of *Euscorpius* Thorell, 1876 from the caves of Croatia and Bosnia-Herzegovina (Scorpiones: Euscorpiidae), with notes on biogeography and cave ecology. *Euscorpius*, 308: 1–15

VACHON, M. 1974. Études des caractères utilisés pour classer les familles et les genres des scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, 3e série, 140 (Zoologie, 104): 857–958.