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TWO NEW SPECIES OF *EUSCORPIUS* (SCORPIONES, EUSCORPIIDAE) FROM SKYROS AND ANDROS ISLANDS, GREECE

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Two New Species of *Euscorpius* (Scorpiones, Euscorpiidae) from Skyros and Andros Islands, Greece. Tropea, G., Fet, V., Parmakelis, A., Stathi, I. — Two new scorpion species are described from Skyros and Andros Islands (Greece), *Euscorpius triantisi* sp. n. and *E. simaiakisi* sp. n. respectively, based on morphological and molecular evidence. Identity and level of divergence of these taxa are confirmed by a phylogeny based on multiple DNA markers (Parmakelis et al., 2013 b). *Euscorpius triantisi* sp. n. forms a sister clade to *E. mylonasi* Fet et al., 2014 from Euboea; the new species is characterized primarily by higher trichobothrial numbers (*Pv* = 8 and *Pe-et* = 6). *E. simaiakisi* sp. n. forms a sister clade to *E. kritscheri* Fet et al., 2013 from Tinos; the new species is primarily characterized by lower trichobothrial numbers (*Pv* = 7 and *Pe-et* = 5).
Key words: Scorpiones, Euscorpiidae, systematics, phylogeny, Aegean, Greece.

Introduction

The genus *Euscorpius* Thorell, 1876, widespread especially 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 the Euscorpiinae of Greece, where, mainly due to the unavailability or a small number of specimens from many areas, both mainland and islands, this genus has been insufficiently studied. In addition, the taxonomic studies of *Euscorpius* are hindered by existence of cryptic species complexes, which are difficult to resolve even with phylogenetic analysis using multiple DNA markers. However, in the recent decade a number of studies delineated and described various new and old taxa of this genus resulting in a significant increase of the number of species in Greece (see Fet et al., 2013, 2014, 2018; Kovařík et al., 2014; Parmakelis et al., 2013 a, b; Tropea & Rossi, 2012; Tropea & Fet, 2015; Tropea et al., 2013, 2014, 2015, 2017, 2020; Kovařík & Šťáhlavský, 2020). In this study, based on multiple DNA markers and morphological evidence, as a part of an ongoing revisionary study of scorpions of Greece and adjacent areas, we describe two new species from Skyros and Andros Islands, *Euscorpius triantisi* sp. n. and *E. simaiakisi* sp. n., increasing the number of valid species of the genus *Euscorpius* in Greece to 29.

Material and methods

The trichobothrial notation follows Vachon (1974). Morphological measurements are given in millimetres (mm) following Tropea et al. (2014) but we use *Wchel* = *Wchel-A*. Morphological nomenclature follows Stahnke (1971), Hjelle (1990), and Sissom (1990); the chela carinae and dentition follows Soleglad & Sissom (2001) but we united *ID+IAD*; and sternum terminology follows Soleglad & Fet (2003).

Depositories: GTC, private collection of Gioele Tropea, Rome, Italy; NHMC, Natural History Museum of Crete, University of Crete, Heraklion, Crete, Greece.

Material studied is listed in detail in the type specimen section.

Sequence data and phylogenetic analyses

The genetic distances separating individual sequences were calculated using MEGA, version 5. The Kimura two-parameter (K2p) model (Kimura, 1980) of nucleotide substitution was used. This distance measure was estimated for each DNA marker separately.

The phylogenetic tree presented herein has been published in Parmakelis et al. (2013 b). Further below we provide the details of the respective phylogenetic analysis. The phylogenetic relationships were estimated in a Bayesian framework, using MrBayes, version 3.1.2 (Ronquist & Huelsenbeck, 2003). In all the Bayesian analyses (BI), a partition of the dataset according to locus was enforced. However, the nuclear fragment (ITS1) was treated as a single locus in all the analyses, even though there were some specimens that included very small parts of either18S or 5.8S. The appropriate substitution models fitting the different partitions were selected using MODELTEST, version3.7 (Posada & Crandall, 1998) and the Akaike information criterion (Akaike, 1974). In every analysis, model parameter values were treated as unknown and were estimated during the MrBayes run. The separate partitions were treated as unlinked, obtaining separate model parameter estimates for each one. In every dataset analysis, the number of generations was set to 6×10^6 and two independent runs were performed simultaneously. In each run, four chains were involved. The mean SD of split frequencies of the two simultaneous and independent runs per formed by MrBayes 3.1.2 was used to determine the stationarity point of likelihoods. According to this index, stationarity in all analyses was achieved well before 0.25×10^6 generations. A tree was sampled every 100th generation and, consequently, the summaries of the BI relied on 12×10^5 samples (sum of two runs). From each run, 45 001 samples were used, whereas 14 999 were discarded as burn in phase. From the remaining 90002 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.

Results

Genus ***Euscorpius*** Thorell, 1876
Subgenus ***Incertus***
Euscorpius triantisi **sp. n.** (figs 1–12; tables 1–4)

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Euscorpius sp. Clade E3: Parmakelis et al., 2013 b: 10 (in part; Skyros);
Euscorpius cf. *mylonasi*: Fet et al., 2014: 12;
Euscorpius cf. *mylonasi* DNA clade E3: Fet et al., 2018: 126, figs. 1, 5.

Figs 1–2. Dorsal and ventral views of *Euscorpius triantisi* sp. n. female holotype.

Type material **(9 ♀). Holotype** ♀: **Greece**: Skyros Island, Acherounes, 500 m from the beach, 2 m a. s. l., 38°51' N, 24°32' E, 20 January 2002, leg. K. Triantis, 1 ♀ (NHMC 3304 Eus15). **Paratypes. Greece:** 1 ♀, Skyros Island, Sporades (old specimen from the Zoological Museum of the University of Athens; NHMC 17587); 2 ♀, Skyros Island, Mt. Kochylas, 792 m, 38°49' N, 24°36' E, 13.05.2002, leg. K. Triantis (NHMC 3242 Eus9, 3242 Eus10); 1 ♀, Skyros Island, Achili maquis, 20.01.2002, leg. K. Triantis (GTC); 1 ♀, Skyros Island, Acherounes, 500 m before the beach, 20.01.2002, leg. K. Triantis (NHMC 3304 Eus14); 1 ♀, Skyros Island, Peramata to Koumari pinewood, 52 m, 38°54' N, 24°27' E, 22.02.2002, leg. K. Triantis (GTC); 2 ♀, Skyros Island, Priona area, 2 km before Agios Efstratios, 160m, 38°53' N, 24°31' E, 24.01.2002, leg. K. Triantis (NHMC 3319 Eus17, 3319 Eus18).

Etymology. The species epithet honours Kostas Triantis, who collected all the specimens of the new species.

Geographic range. Known only from Skyros Island (see map in fig. 26).

Diagnosis. A small *Euscorpius* species, total length around 22–29 mm. Colour of adults from reddish to very light brown-reddish, with very slight reticulations or marbling on the carapace, mesosoma and metasoma, but never on chelicerae, telson and pedipalps. The number of trichobothria on the pedipalp manus ventral surface is 4 (V_{1-3}+Et_1); trichobothria *et* and *est* on fixed finger are located distally to the notch of the fixed finger and *dsb* is located proximally to the notch. The number of ventral trichobothria on the pedipalp patella usually is *Pv* = 8; the number of external trichobothria on pedipalp patella usually is: *eb* = 4, eb_a = 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 6. The pectinal teeth number mostly is 7 in females (males are unknown). Chela carina *V1* follows a direction toward the external of the trichobothrium Et_1, without forming a "Y" configuration. Dorsal patellar spur well developed. Femur of pedipalp slightly shorter than patella. Carapace in females usually as long as wide or slightly longer than wide. Metasomal segment in females I markedly wider than long. Metasomal carinae on segment V with serrulated and spaced granules. Ventral row of tarsus III ending with a decentralized spinule, without to form a "Y" formation. Average distance from centre of median eyes to the anterior margin of the carapace is 41.99 % of the carapace length in females. Telson usually slightly wider than high in females.

Table 1. Measurements (mm) of holotypes of *E. triantisi* sp. n. and *E. simaiakisi* sp. n.

Morphological features	Parameter	*E. triantisi* sp. n. ♀ holotype	*E. simaiakisi* sp. n. ♀ holotype
Total	L	22.48	24.12
Carapace	L / W	3.70 / 3.60	3.80 / 4.10
Metasoma	L	8.78	8.82
Segment I	L / W	1.18 / 1.40	1.12 / 1.30
Segment II	L / W	1.40 / 1.20	1.40 / 1.15
Segment III	L / W	1.50 / 1.15	1.50 / 1.12
Segment IV	L / W	1.80 / 1.10	1.80 / 1.10
Segment V	L / W	2.90 / 1.00	3.00 / 1.06
Telson	L	3.00	2.90
Vesicle	L / W / H	2.00 / 1.10 / 1.00	2.00 / 1.00 / 1.00
Aculeus	L	1.00	0.90
Femur	L / W	2.90 / 1.20	3.20 / 1.25
Patella	L / W	3.10 / 1.15	3.30 / 1.40
Chela	L / W	6.10 / 2.36	6.40 / 2.70
Movable finger	Length	3.08	3.60
Ratio	CarA %	41.89	41.58
	Lcar/Wcar	1.03	0.93
	Lcar/Lpat	1.19	1.15
	Lcar/Ltel	1.23	1.31
	Lfem/Lpat	0.93	0.97
	Lchel/Wchel	2.58	2.37
	Htel/Wtel	0.91	1.00
	Ltel/Htel	3.00	2.90
	Lmet/ met.seg V	3.03	2.94
	Lmet/Lcar	2.37	2.32
	Lmet/Wmet	1.50	1.54
	L/W met.seg I	0.84	0.86
	L/W met.seg II	1.17	1.22
	L/W met.seg III	1.30	1.34
	L/W met.seg IV	1.64	1.64
	L/W met.seg V	2.90	2.83

Description of the female holotype (NHMC 3304 Eus 15)

Colouration. Whole colour is medium brown without marbling, with carapace and pedipalps with reddish trend and lighter legs; the telson and the chelicerae are yellow without marbling; sternites, pectines and genital operculum whitish/ivory, the sternites are very light brownish.

Carapace. With a fine and homogeneous granulation on most of surface; anterior edge straight; posterior lateral, anterior median and posterior median furrows are present; two pairs of lateral eyes and a pair of median eyes, situated distally of the middle, are present; distance from centre of median eyes to anterior margin is 41.89 % of carapace length.

Mesosoma. Tergites mostly smooth but laterally with few very little granules; sternites are smooth or very finely punctuated. Spiracles small, oval shaped and inclined about 45° downward towards outside.

Metasoma. Dorsal carinae on segments I–IV granulates; ventrolateral carinae on segment I absent, on segment II and III obsolete or smooth, on segment IV present with a few small granules, on segment V present with serrulated and spaced granules; ventromedian carina on segments I–IV absent, on segment V formed by serrulated and spaced granules placed in a row for most of the length, but in the distal part it almost becoming two lines

Table 2. Genetic distances between *16S rRNA* sequences. The number of base substitutions per site is shown. Standard error estimates are shown above the diagonal and were obtained by a bootstrap procedure (1000 replicates). Analyses were conducted using the Kimura two-parameter (K2p) model (Kimura,1980). The rate variation among sites was modeled with a gamma distribution

	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*E. stahlavskyi*		0,021	0,022	0,019	0,018	0,020	0,020	0,023	0,022	0,020	0,022	0,020	0,025	0,019	0,022
2	*E. avcii*	0,121		0,018	0,016	0,015	0,021	0,019	0,011	0,010	0,014	0,015	0,016	0,020	0,017	0,021
3	*E. tergestinus*	0,109	0,088		0,013	0,012	0,017	0,020	0,023	0,018	0,021	0,019	0,017	0,017	0,020	0,018
4	*E. kinzelbachi*	0,098	0,078	0,057		0,009	0,016	0,016	0,020	0,019	0,018	0,017	0,013	0,014	0,017	0,016
5	*E. scaber*	0,090	0,071	0,044	0,034		0,014	0,015	0,018	0,016	0,016	0,015	0,014	0,014	0,015	0,017
6	*E. erymanthius*	0,097	0,105	0,078	0,075	0,057		0,017	0,021	0,024	0,021	0,020	0,021	0,019	0,018	0,015
7	*E. popovi*	0,108	0,101	0,094	0,070	0,067	0,075		0,018	0,021	0,019	0,018	0,016	0,017	0,017	0,019
8	*E. amorgensis*	0,134	0,037	0,116	0,095	0,088	0,106	0,098		0,012	0,016	0,016	0,019	0,021	0,019	0,021
9	*E. curcici*	0,129	0,039	0,092	0,094	0,081	0,125	0,116	0,046		0,017	0,017	0,017	0,021	0,018	0,022
10	*E. vignai*	0,115	0,062	0,110	0,089	0,081	0,106	0,095	0,072	0,076		0,017	0,018	0,017	0,014	0,016
11	*E. lesbiacus*	0,126	0,074	0,097	0,082	0,078	0,097	0,093	0,082	0,085	0,082		0,018	0,020	0,018	0,019
12	*E. kritscheri*	0,111	0,084	0,075	0,059	0,066	0,109	0,080	0,102	0,087	0,090	0,096		0,013	0,016	0,018
13	*E. simaiakisi* sp. n.	0,139	0,104	0,077	0,065	0,068	0,093	0,081	0,109	0,116	0,088	0,110	0,055		0,017	0,017
14	*E. triantisi* sp. n.	0,105	0,091	0,102	0,084	0,074	0,092	0,085	0,102	0,094	0,069	0,093	0,075	0,085		0,015
15	*E. mylonasi*	0,111	0,103	0,086	0,071	0,078	0,070	0,084	0,104	0,107	0,076	0,095	0,078	0,075	0,063	

Table 3. Genetic distances between *COI mtDNA* sequences. The number of base substitutions per site is shown. Standard error estimates are shown above the diagonal and were obtained by a bootstrap procedure (1000 replicates). Analyses were conducted using the Kimura two-parameter (K2p) model (Kimura,1980). The rate variation among sites was modeled with a gamma distribution

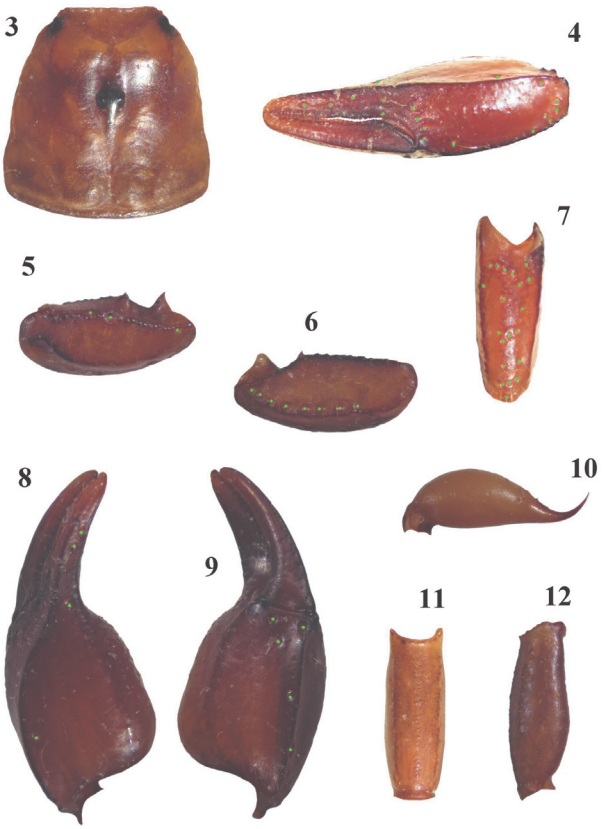
	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	*E.stahlavskyi*		0,017	0,019	0,017	0,016	0,018	0,015	0,018	0,016	0,015	0,016	0,016	0,016	0,017	0,016
2	*E. avcii*	0,126		0,016	0,016	0,016	0,017	0,015	0,014	0,012	0,014	0,015	0,014	0,016	0,018	0,016
3	*E. tergestinus*	0,134	0,102		0,016	0,014	0,016	0,015	0,016	0,015	0,016	0,017	0,012	0,015	0,014	0,014
4	*E. kinzelbachi*	0,116	0,105	0,113		0,015	0,015	0,016	0,016	0,015	0,016	0,018	0,014	0,016	0,016	0,014
5	*E. scaber*	0,113	0,100	0,088	0,095		0,017	0,011	0,014	0,013	0,014	0,012	0,013	0,014	0,013	0,013
6	*E. erymanthius*	0,137	0,110	0,103	0,111	0,118		0,016	0,017	0,016	0,017	0,018	0,018	0,018	0,016	0,015
7	*E. popovi*	0,106	0,096	0,093	0,108	0,075	0,113		0,014	0,014	0,014	0,012	0,014	0,014	0,014	0,013
8	*E. amorgensis*	0,127	0,081	0,099	0,101	0,081	0,112	0,096		0,011	0,016	0,015	0,014	0,014	0,016	0,013
9	*E. curcici*	0,116	0,058	0,093	0,103	0,078	0,111	0,093	0,060		0,014	0,015	0,015	0,013	0,015	0,014
10	*E. vignai*	0,106	0,093	0,100	0,108	0,095	0,116	0,099	0,099	0,081		0,015	0,014	0,015	0,015	0,014
11	*E. lesbiacus*	0,111	0,110	0,121	0,118	0,071	0,124	0,075	0,099	0,103	0,113		0,016	0,015	0,015	0,013
12	*E. kritscheri*	0,112	0,085	0,070	0,092	0,089	0,120	0,089	0,089	0,087	0,089	0,117		0,011	0,015	0,014
13	*E. simaiakisi* sp. n.	0,117	0,100	0,099	0,109	0,098	0,128	0,095	0,087	0,087	0,109	0,107	0,064		0,015	0,014
14	*E. mylonasi*	0,118	0,116	0,095	0,103	0,083	0,113	0,088	0,099	0,100	0,105	0,100	0,092	0,097		0,011
15	*E. triantisi* sp. n.	0,108	0,102	0,093	0,083	0,074	0,108	0,081	0,074	0,088	0,088	0,081	0,087	0,089	0,056	

Table 4. GenBank accession numbers of the DNA sequences used for estimating genetic divergence. *E. avcii* are from Parmakelis et al. (2013 a), all others from Parmakelis et al. (2013 b)

Species	Locality	Accession number and references	
		16S rRNA	COI
E. stahlavskyi	Greece, Epiros, Mt. Smolikas	KC215653	KC215739
E. avcii	Turkey, Dilek Peninsula	KF030937	KF030935
E. tergestinus	Croatia, Rab Island, Jurine, Banjol	KC215656	KC215742
E. kinzelbachi	Greece, Thessaly, Mt. Olympos	KC215615	KC215694
E. scaber	Greece, Thasos Island, Skala Sotiros	KC215650	KC215736
E. erymanthius	Greece, Peloponnese, Kalentzi Mt.	KC215620	KC215704
E. popovi	Bulgaria, Blagoevgrad Prov., Melnik	KC215651	KC215737
E. amorgensis	Greece, Amorgos Island, Agios Georgios	KC215606	KC215690
E. curcici	Greece, Cyclades Islands, Sikinos Island, Chorio	KC215598	KC215681
E. mylonasi	Greece, Evvoia Island, Nea Styra Islet	KC215657	KC215743
E. vignai	Greece, Karpathos Island, Arkasa	KC215649	KC215735
E. lesbiacus	Greece, Lesvos Island, Mt. Lepetymnos	KC215648	KC215734
E. triantisi sp. n.	Greece, Skyros Island	KC215593	KC215676
E. simaiakisi sp. n.	Greece, Andros Island, Menites	KC215605	KC215689

forming a rough "Y" configuration; intercarinal spaces on segments dorsally very finely granulated, the remaining parts are mostly smooth. Dorsal furrows little marked.

Telson. Slightly wider than high. Vesicle smooth, with ventral setae of different sizes, especially around the vesicle/aculeus juncture.



Figs 3–12. *Euscorpius triantisi* sp. n. female holotype: 3 — carapace; 4 — external view of chela; 5 — dorsal view of pedipalp patella; 6 — ventral view of pedipalp patella; 7 — external view of pedipalp patella; 8 — dorsal view of chela; 9 — ventral view of chela; 10 — telson; 11 — ventral view of the metasomal segment V; 12 — lateral view of the metasomal segment V.

Figs 13–14. Dorsal and ventral views of *Euscorpius simaiakisi* sp. n. female holotype.

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

Genital operculum. The genital operculum is formed by two longitudinally separated subtriangular sclerites.

Sternum. Pentagonal shape, type 2; wider than long, deep posterior emargination.

Pedipalps. Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal carinae tuberculated; dorsal external carinae formed by tubercles slightly serrulated; ventral external carinae irregular, present mostly in the proximal 2/5; external median carinae serrulated; anterior median formed by about 8 more noticeable conical tubercles, of which three bear a macroseta each; intercarinal spaces finely granulated. Patella: dorsal and ventral internal carinae tuberculated, the latter slightly serrulated; dorsal external carinae from smooth and rounded in proximal to slightly crenulated distally; ventral external carinae crenulated; intercarinal surface ventrally and externally almost smooth, dorsally and internally finely granulated. Dorsal patellar spur (DPS) well-developed. Chela: carina *D1* is distinctly strong, dark and mostly smooth; *D4* formed by dark, very low and weakly marked tubercles; *V1* is distinctly strong, dark and crenulated, without forming a Y" configuration; *V3* is rounded, dark, with a few small and scattered granules; intercarinal internal tegument granulated, the remaining parts are mostly smooth; notch and lobe on fixed and movable fingers are barely noticeable.

Trichobothria. Chela: trichobothria on the pedipalp manus ventral surface $V = 3/3$ ($V_{1\text{-}3}$) + $Et_1 = 1/1$; the trichobothrium V_4 is situated on the external surface very near to the carina V_1; the trichobothria *et* and *est* are located distally to the notch, and the trichobothrium *dsb* is located proximally to the notch; *et-est*/*est-dsb* ratio is about 1. Patella: ventral (*Pv*): 8/8; external (*Pe*): *et* = 6/6, *est* = 4/4, *em* = 4/4, *esb* = 2/2, eb_a = 4/4, *eb* = 4/4. Femur:

trichobothrium *d* on femur is proximal to *i,* while the trichobothrium *e* is distal to both, situated on dorsal external carina.

Legs. Legs with two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 10/10 spinules of increasing size from proximal to distal, ending with a decentralized spinule, without forming a "Y" configuration; 3 larger flanking pairs of tarsal setae adjacent to the ventral spinules row are presents. Tubercles present on ventral and dorsal surface of all leg femora; they are more marked and darker ventrally; on legs IV the tubercles are few and less evident.

Chelicerae. Typical of the subfamily Euscorpiinae.

Trichobothrial and pectinal teeth count variation. Pectinal teeth in females (n = 18): 6/6 (1), 7/7 (7), 8/7 (1); in total, 6 in 11.11 % (2), 7 in 83.33 % (15) and 8 in 5.55 % (1); mean = 6.94, SD = 0.42.

Pedipalp patella trichobothria *Pv* (n = 18): 7/7 (1), 8/8 (5), 8/9 (1), 9/8 (2); in total, 7 in 11.11 % (2) and 8 in 72.23 % (13) and 9 in 16.67 % (3); mean =8.05, SD = 0.54.

Pedipalp patella trichobothria *Pe* (n = 18): *et* = 6/6 (8), 7/6 (1); in total, 6 in 94.44 % (17) and 7 in 5.56 % (1); mean = 6.05, SD = 0.24; *est* = 4/3 (2), 4/4 (7); *em* = 3/4 (1), 4/4 (8); *esb* = 2/2 (9); eb_a = 4/3 (1), 4/4 (8); *eb* = 4/4 (9).

Discussion

The population from Skyros described here as *Euscorpius triantisi* sp. n. has already been taken into consideration by Parmakelis et al. (2013 b) and Fet et al. (2014). In Parmakelis et al. (2013 b), it was shown as a part of the clade E3, as a sister clade of a population from the island of Euboea (fig. 25). Fet et al. (2014), based on the results of Parmakelis et al. (2013 b), described the latter as a new species, *E. mylonasi*, and reported some differences between *E. mylonasi* and the population from Skyros. They reported the trichobothrial and *Dp* values of 11 specimens. We here consider only 9 specimens as belonging to the new species from Skyros. The additional two specimens, which originate from the nearby islet of Mesa Diavatis (38°47.816′ N 24°31.524′ E) show a higher *et* average values (7 in three pedipalps and 6 in one versus 7 in one pedipalp and 6 in seventeen pedipalps in the specimens from Skyros) and, although they are subadults, they are larger than the adults from Skyros Island. Such trichobothrial variation in small island populations has been constantly observed in the genus *Euscorpius* (see e. g. Soleglad & Fet, 2004: 105, on *E. balearicus* from the Balearic Islands) and could serve as a morphological marker of incipient parapatric speciation.

Fet et al. (2014) also stated that the 11 specimens they examined could potentially represent a separate species, but in the absence of adult males their status remains unclear. In recent years we have not had the opportunity to examine adult males, however, in our opinion that the status of the population from Skyros as a separate species is unquestionable, even without the description of the adult males; therefore, we have described it here as a new species.

In fact, *E. triantisi* sp. n. is genetically well separated from any other species, as can be seen in the phylogenetic tree (fig. 25, modified after Parmakelis et al., 2013 b), and has a genetic divergence from *E. mylonasi*, the sister species, of 6.3 % in *16S* and of 5.6 % in COI, which is higher than between many other species of Euscorpiinae.

Morphologically, the two species differ mainly in having (1) *Pv* = 8 in *E. triantisi* sp. n. and *Pv* = 7 in *E. mylonasi*, (2) *et* = 6 in *E. triantisi* sp. n. versus *et* = 5 in *E. mylonasi*, and (3) the ventromedian carina on segments V formed by serrulated and spaced granules in *E. triantisi* sp. n. versus a ventromedian carina on segment V absent, obsolete or with very few, spaced, small and hardly visible granules in *E. mylonasi*. Furthermore, the two species are geographically well separated, the new species being present on Skyros Island at about 35 km away from the closest point.

***Euscorpius simaiakisi* sp. n.** (figs 13–24; tables 1–4)

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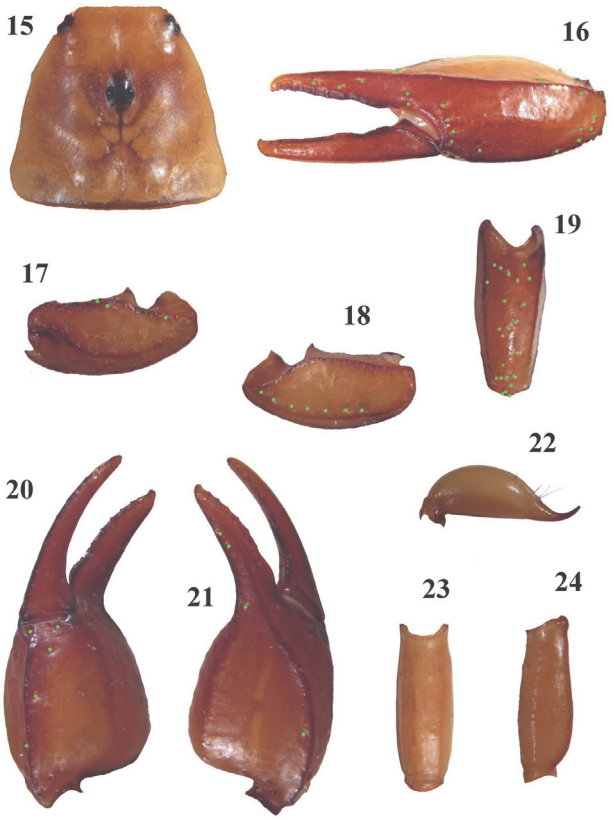
Euscorpius carpathicus: Stathi & Mylonas, 2001: 289 (in part; Andros);
Euscorpius sp. Clade E5: Parmakelis et al., 2013b: 10 (in part; Andros);
Euscorpius cf. *kritscheri*: Fet et al., 2013: 9;
Euscorpius cf. *kritscheri* DNA clade E5: Fet et al., 2018: 126, 130-131, figs. 1, 8.

Type material (9 specimens: 2 ♂, 7 ♀). **Holotype** ♀: Andros Island, Evrousies, dry wall along the stream, east of springs, 590 m, 37°50' N, 24°53' E, 23 April 2011, leg. S. Simaiakis (NHMC 13221 Eus7). **Paratypes. Greece:** 2 ♂: Andros Island, Chora, harbor, 37°50' N, 24°56' E, 9.11.1978, leg. M. Mylonas (NHMC 1128 Eus74); 1 ♀: Andros Island, Vitali, 37°55' N, 24°48' E, 3.09.1979, leg. M. Mylonas, (NHMC 1134 Eus72); 1 ♀: Andros Island, Menites, dense phrygana, 37°49' N, 24°54' E, 1.05.2002, leg. S. Simaiakis (NHMC 4422 Eus73); 1 ♂ imm.: Andros, Vourkoti dirt road to Profitis Ilias peak, W of the village, 730 m, 37°51' N, 24°53' N, 23.04.2011, leg. S. Simaiakis (NHMC 13220 Eus5); 1 ♀ imm.: Andros, Pitrofos, in yard, 425 m, 37°48' N, 24°52' E, 25.04.2011 leg. S. Simaiakis, (NHMC 13239 Eus4); 1 ♂ imm., 1 ♀: Andros Island, Evrousies, dry wall along the stream, east of springs, 590 m, 37°50' N, 24°53' E, 23.04,2011, leg. S. Simaiakis (NHMC 13221 Eus7).

Etymology. The species epithet honours Stylianos Simaiakis, who collected most of the specimens of the new species.

Geographic range. Known only from Andros Island (see map in fig. 26).

Diagnosis. A small *Euscorpius* species, total length around to 24–27 mm. Colour of adults from very light brown-reddish to medium brown, with or without reticulations



Figs 15–24. *Euscorpius simaiakisi* sp. n. female holotype: 15 — carapace; 16 — external view of chela; 17 — dorsal view of pedipalp patella; 18 — ventral view of pedipalp patella; 19 — external view of pedipalp patella; 20 — ventral view of chela; 21 — dorsal view of chela; 22 — telson; 23 — ventral view of the metasomal segment V; 24 — lateral view of the metasomal segment V.

or marbling on the carapace, mesosoma and metasoma, but never on chelicerae, telson and pedipalps. The number of trichobothria on the pedipalp manus ventral surface is 4 ($V_{1\text{-}3}$+Et_1); trichobothria *et* and *est* on fixed finger are located distally to the notch of the fixed finger and *dsb* is located proximally to the notch. The number of ventral trichobothria on the pedipalp patella usually is *Pv* = 7; the number of external trichobothria on pedipalp patella usually is: *eb* = 4, eb_a = 4, *esb* = 2, *em* = 4, *est* = 4, *et* = 5. The pectinal teeth number mostly is 7 in females, and 8 in males. Chela carina *V1* follows a direction toward the

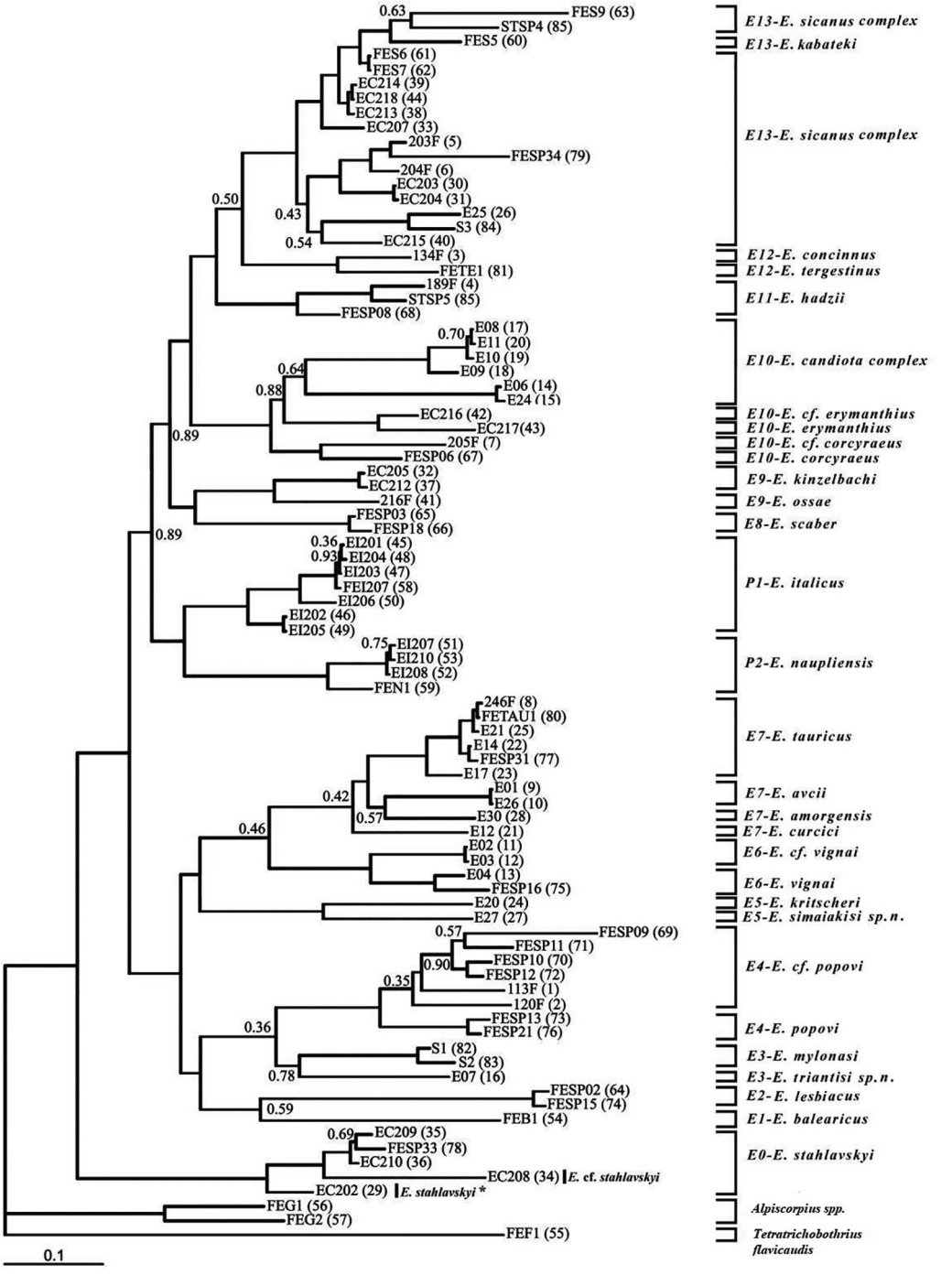


Fig. 25. Phylogenetic tree (modified after Parmakelis et al., 2013 b).

external of the trichobothrium Et_1. Dorsal patellar spur (DPS) well developed. Femur of pedipalp slightly shorter than patella. Carapace usually slightly wider than long in females. Metasomal segment I wider than long in females. Ventrolateral metasomal carinae on segment V present with small, serrulated and widely spaced granules. Ventromedian metasomal carinae on segment V formed by very small, spaced and serrulated granules.

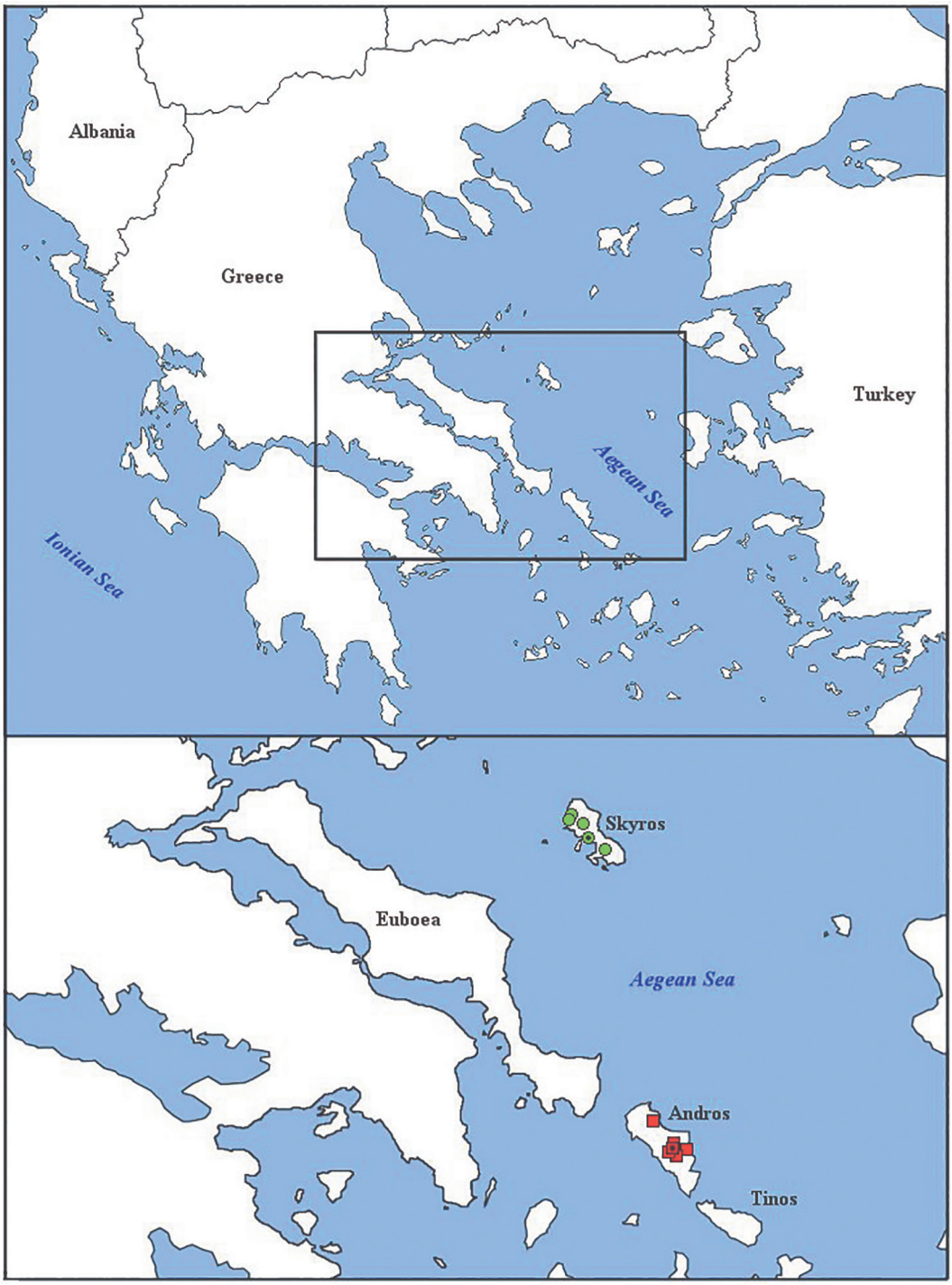


Fig. 26. Map indicating localities of the examined specimens of two new species (red squares, *E. triantisi* sp. n.; green circles, *E. simaiakisi* sp. n.; black dot marks type locality).

Ventral row of tarsus III ending with a decentralized spinule, without forming a "Y" configuration. Average distance from centre of median eyes to the anterior margin of the carapace is 41.86 % of the carapace length in females. Telson usually as wide as high in females.

Description of the female holotype (NHMC 13221 Eus 7)

Colouration. Whole colour is light brown with darker marbling on carapace and mesosoma, with carapace and pedipalps with reddish trend and lighter legs; the telson and the chelicerae are yellow without marbling; sternites, pectines and genital operculum whitish/ivory, the sternites are very light brownish.

Carapace. With a fine and homogeneous granulation on most of surface; anterior edge straight; posterior lateral, anterior median and posterior median furrows are present; two pairs of lateral eyes and a pair of median eyes, situated distally of the middle, are present; distance from centre of median eyes to anterior margin is 41.58% of carapace length.

Mesosoma. Tergites mostly smooth but laterally with a few very little granules; sternites are smooth or very finely punctated. Spiracles small, oval shaped and inclined about 35° downward towards outside.

Metasoma. Dorsal carinae on segments I–IV with very few, low, clear and hardly visible tubercles; ventrolateral carinae on segment I absent, on segment II and IV obsolete or smooth, on segment V present with small, serrulated and widely spaced granules; ventromedian carina on segments I–IV absent, on segment V formed by very small, spaced and serrulated granules; intercarinal spaces smooth. Dorsal furrows weakly marked.

Telson. Slightly wider than high. Vesicle smooth, with ventral setae of different sizes, especially around the vesicle/aculeus juncture.

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

Genital operculum. The genital operculum is formed by two longitudinally separated subtriangular sclerites.

Sternum. Pentagonal shape, type 2; wider than long, deep posterior emargination.

Pedipalps. Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal carinae tuberculated; dorsal external carinae formed by tubercles slightly serrulated; ventral external carinae irregular, present mostly in the proximal 2/5; external median carinae serrulated; anterior median formed by about 7 or 8 more noticeable conical tubercles, of which three bear a macroseta each; intercarinal spaces from finely to medially granulated. Patella: dorsal and ventral internal carinae tuberculated, the latter slightly serrulated; dorsal external carinae mostly crenulated, with tubercles becoming clearer and more detached, with the more proximal part without them; ventral external carinae formed by low tubercles distally, which gradually become granules proximally; intercarinal surface ventrally and externally smooth, dorsally with just a few granules, and internally finely granulated. Dorsal patellar spur well-developed. Chela: carina *D1* is distinctly strong, dark and from smooth a slightly crenulated; *D4* formed by dark and low tubercles; *V1* is distinctly strong, dark and from tuberculated proximally to slightly crenulated, forming a weakly pronounced "Y" configuration; *V3* is rounded, slightly darker than the adjacent area, with a few small and scattered granules; intercarinal internal tegument granulated, the remaining parts are mostly smooth; notch and lobe on fixed and movable fingers are barely notable; finger dentition: a *DD* is present in the distalmost part on the tip; *MD* is formed by very small denticles closely spaced forming a more or less straight line, discontinued at level of the *OD*; fixed finger has 7/7 *OD* and 10/11 *ID*; movable finger has 8/8 *OD* and 15/13 *ID*.

Trichobothria. Chela: trichobothria on the pedipalp manus ventral surface $V = 3/3$ ($V_{1\text{-}3}$) + $Et_1 = 1/1$; the trichobothrium V_4 is situated on the external surface very near to

the carina V_1; the trichobothria *et* and *est* are located distally to the notch, and the trichobothrium *dsb* is located just proximal to the middle of the notch; *et-est*/*est-dsb* ratio is about 1.17/1.08. Patella: ventral (*Pv*): 7/7; patella external (*Pe*): *et* = 5/5, *est* = 4/4, *em* = 4/4, *esb* = 2/2, eb_a = 3/4, *eb* = 4/4. Femur: trichobothrium *d* on femur is proximal to *i,* while the trichobothrium *e* is distal to both, situated on dorsal external carina.

Legs. Legs with two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 9/9 spinules of increasing size from proximal to distal, ending with a decentralized spinule, without forming a "Y" configuration; 3 larger flanking pairs of tarsal setae adjacent to the ventral spinules row are present. Tubercles present on ventral and dorsal surface of all leg femora, they are more marked and dark ventrally, but on the fourth pair the tubercles are ventrally few, and less evident.

Chelicerae. Typical of the subfamily Euscorpiinae.

Trichobothrial and pectinal teeth count variation. Pectinal teeth in males (n = 4): 8/8 (2); in total, 8 in 100 % (4); mean = 8, SD = 0.

Pectinal teeth in females (n = 14): 7/6 (1), 7/7 (5), 8/8 (1); in total, 6 in 7.14 % (1), 7 in 78.57 % (11), and 8 in 14.29 % (2); mean = 7.07, SD = 0.47.

Pedipalp patella trichobothria *Pv* (n = 18): 7/6 (1), 7/7 (7), 7/8 (1); in total, 6 in 5.55 % (1), 7 in 88.89 % (16) and 8 in 5.55 % (1); mean =7, SD = 0.34.

Pedipalp patella trichobothria *Pe* (n = 18): *et* = 5/5 (9); in total, 5 in 100 % (18); mean = 5, SD = 0; *est* = 4/3 (1), 4/4 (8); *em* = 3/3 (1), 4/4 (7); *esb* = 2/2 (9); eb_a = 3/4 (1), 4/4 (8); *eb* = 4/4 (9).

Discussion

The population described here as *E. simaiakisi* sp. n. has already been taken into consideration by Parmakelis et al. (2013 b) and Fet et al. (2013). Parmakelis et al. (2013 b) show it as a part of the DNA clade E5, as a sister clade of a population from Tinos (fig. 25). Fet et al. (2013), guided by the results of Parmakelis et al. (2013 b), described the new species *E. kritscheri* from Tinos. They reported some differences between *E. kritscheri* and the population from Andros. However, due to the lack of adult males from Andros for morphological analysis they refrained from describing this population as a new species.

In recent years we have not had the opportunity to examine adult males; however, we think that even without this information the status of the population from Andros as a separate species is unquestionable; it is therefore described here. In fact, *E. simaiakisi* sp. n. is genetically well separated from all other species, as can be seen in the phylogenetic tree (fig. 25, modified after Parmakelis et al., 2013 b), and has a genetic divergence from *E. kritscheri*, the closest species, of 5.5 % in *16S* and of 6.4 % in *COI*, which is higher than among many other species of Euscorpiinae.

Morphologically, the two species differ primarily in having: (1) *Pv* = 7 in *E. simaiakisi* sp. n. and *Pv* = 7 and 8 in *E. kritscheri*, (2) *et* = 5 in *E. simaiakisi* sp. n. versus *et* = 6 in *E. kritscheri*, and (3) *Dp* = 8 in males and 7 in females in *E. simaiakisi* sp. n. and *Dp* = 7 in males and 6 and 7 in females in *E. kritscheri.*

It should be noted that in the material considered as *E.* cf. *kritscheri* by Fet et al. (2013), they misidentified one immature female specimen found in the same vial as the holotype of *E. simaiakisi* sp. n., that corresponds in all its features to *E. birulai* Fet et al., 2014. *E. birulai* is only known from Agia Triada Cave in the south of Euboea Island, not far from Andros Island, so its presence would be nothing unexpected or unlikely on Andros. However, the fact that another species known from Euboea Island, *E. mylonasi*, is phylogenetically very distant from the species on Andros and Tinos, creates a possibility that this specimen could be a different cryptic species, related to *E. birulai*. The possibility that this specimen could have been introduced on Andros, or been placed in the wrong vial, should also be taken into consideration, even though *E. birulai* is a troglophile and very rare species, which makes

these possibilities quite remote. To confirm that *E. birulai* or a different related species is present on Andros, additional specimens and desirably genetic analyses are required.

Authors′ responsibilities

Morphological descriptions and photographs were produced by GT. AP extracted and sequenced DNA and analyzed molecular data. The text was mostly written by GT. The specimen handling, exchange and management was done by IS and VF; the curation of the NHMC collection is done by IS.

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