

Original paper

## A new *Alpiscorpius* from İstanbul Province of Turkey (Scorpiones: Euscorpiidae)

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**Summary.** A new scorpion species, *Alpiscorpius istanbulensis* sp. n., from İstanbul Province, Turkey, is described based on morphological and molecular evidence, raising the number of Euscorpiinae species to 19, including 12 related or phylogenetically close to the genus *Alpiscorpius*.

**Keywords:** *Alpiscorpius*, euscorpiidae, euscorpiinae, scorpion, taxonomy, Turkey.

### INTRODUCTION

The scorpion taxa of the Euscorpiinae subfamily are among the most studied groups of scorpions. They are very common in southern Europe and Anatolia, where species occupy diverse habitats from sea level to over 2,700 masl (Tropea et al. 2015, 2016b). The taxonomy of this subfamily is complicated and still unresolved throughout its range. Over the last few years, our group has intensively studied the Euscorpiinae in Turkey, resulting in a significant increase in the number of species identified in this country. Since 2012, the number of species in Turkey has increased from 2 to 18, not including the new species described herein (Tropea et al. 2012, 2014, 2015, 2016a, 2016b, 2017; Yağmur and Tropea 2013, 2015, 2017; Yağmur et al. 2013; Tropea and Yağmur 2015, 2016a, 2016b). In addition, Fet et al. (2016) published a phylogeny on populations related to the subgenus *Alpiscorpius* Gantenbein et al., 1999 in Turkey. In the present study, we describe a new *Alpiscorpius* species, *A. istanbulensis* sp. n., based on genetic and morphological evidences, as part

of an ongoing study on the populations of the subfamily Euscorpiinae in Turkey. The Euscorpiinae species currently recognized in Turkey has now been increased to 19, including 12 related or phylogenetically close to the genus *Alpiscorpius*.

### MATERIAL AND METHODS

The trichobothrial notation follows Vachon (1974). Morphological measurements are given in millimetres (mm) following Tropea et al. (2014), although we use *Wchel* = *Wchel-A*. Morphological nomenclature follows Stahnke (1971), Hjelle (1990), and Sissom (1990); the chela carinae and dentition follows Soleglad and Sissom (2001), however we united *ID+IAD*; hemispermatophore nomenclature follow Molteni et al. (1983) and Fet et Soleglad (2002) and this document; sternum terminology follows Soleglad and Fet (2003).

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

In order to obtain sequence mitochondrial Cytochrome

Oxidase Subunit I (COI) data for the specimens under study, DNA extraction, PCR amplification of COI fragments and sequencing were performed as described in Parmakelis et al. (2013). Generated sequence data was compared to other available COI sequences of Euscorpiinae species (Table 1). Analyses were conducted using the Tamura-Nei model (Tamura and Nei 1993). The rate variation among sites was modelled with a gamma distribution (shape parameter = 1). The analysis involved 11 nucleotide sequences. All ambiguous positions were removed for each sequence pair. There were a total of 555 positions in the final dataset. Evolutionary analyses were conducted in MEGA5 (Tamura et al. 2011).

## RESULTS

### Systematics

Family Euscorpiidae Laurie, 1896  
 Subfamily Euscorpiinae Laurie, 1896  
 Genus *Alpiscorpius* Gantenbein et al., 1999  
 Subgenus *incertus*

*Alpiscorpius istanbulensis* sp. n.  
 (Figs 1-28)

### Examined specimens

Turkey: İstanbul, Şile District, Agva Area, Evrenli village, 41°05'48"N 29°45'36.00"E, 84 m, 03 April 2010, Leg. A. Y. Guler, 1♀ (AZMM/Sco-2010:32, holotype); same data but 3♀ (GTC paratypes).

İstanbul, Beykoz District, Polonezköy Town, 4 km west, 41°07'06"N 29°09'31"E, 201 m, 11 July 2020, Leg. E. A. Yağmur, G. Gündüz, A. Taşçı, Ö. Sipahioğlu, 74♂, 26♀ (AZMM/Sco-2020:24-123); same place, 8 August 2019, Leg. Gündüz, 2♂, 1♀ (AZMM/Sco-2019:14-16); İstanbul, Kartal District, Aydos Forest, 40°56'39"N 29°14'28"E, 280 m, 30 April 2016, Leg. E. A. Yağmur, R. S. Kaya, Y. Gürkan, 5♂, 27♀ (AZMM/Sco-2016:1-32); same place, 10 July 2020, Leg. E. A. Yağmur, G. Gündüz, E. A. Sipahioğlu, 1♂ (AZMM/Sco-2020:124).

### Etymology

The species epithet refers to the name of the province of "İstanbul" in which the specimens of the new species were collected, and the Latin suffix *-ensis*.

**Table 1.** DNA sequences used for estimates of evolutionary divergence.

Species	Locality	Accession numbers COI mtDNA
<i>E. stahlavskyi</i>	Greece, Epiros, Mt. Smolikas	KC215739 (Parmakelis et al. 2013)
<i>E. alanyaensis</i>	Turkey, Antalya, Taşatan Plateau	KX807081 (Tropea et al. 2016b)
<i>E. gocmeni</i>	Turkey, Antalya, Murtici Village	KX807084 (Tropea et al. 2016b)
<i>A. zloporubovici</i>	SERBIA. Tara River, Kaluderske Bare	HM418278 (Graham et al. 2012)
<i>A. cf. dinaricus</i>	BOSNIA & HERZEGOVINA. Lebršnik, 43.2019°N, 18.6378°E	HM418276 (Graham et al. 2012)
<i>A. ypsilon</i>	AUSTRIA. Carinthia: Trögerner-Klamm	HM418273 (Graham et al. 2012)
<i>A. phrygius</i>	Turkey, Bolu Province, Mt. Abant	KU987042 (Tropea et al. 2016a)
<i>A. mingrelicus</i>	Turkey, Rize Province, Çamlıhemşin, near Şenköy village	KT764037 (Fet et al. 2016)
<i>E. idaeus</i>	TURKEY. Canakkale Province: Bayramic District, Evciler, Ayazma	KT764043 (Fet et al. 2016)
<i>E. eskisehirensis</i>	TURKEY. Eskişehir Province: Mihaliççık District, Otluk Village	KT764046 (Fet et al. 2016)
<i>A. istanbulensis</i> sp. n.	İstanbul, Şile District, Agva Area, Evrenli village, 84 m	PP786525 (this document)

*A.* = *Alpiscorpius*, *E.* = *Euscorpius*.



Figs 1-2. Dorsal and ventral view of *Alpiscorpius istanbulensis* sp. n. male.

### Diagnosis

A small Euscorpiinae species, average total length 25 mm. Adults are coloured mostly dark brown with darker marbling over the whole body. The number of trichobothria on the pedipalp manus ventral surface is 4 ( $V_{1-3}+Et_1$ ).

Trichobothrium *est* on fixed finger is located proximally to, or on, the centre of the notch of the fixed finger. The number of trichobothria on the pedipalp patella ventral surface is usually 6. The number of trichobothria on pedipalp patella external surface is usually:  $eb = 4$ ,  $eb_a = 4$ ,  $esb = 2$ ,  $em = 3$ ,  $est = 4$ ,  $et = 4$ . The number of pectinal teeth in males is mostly 7



**Figs 3-4.** Dorsal and ventral view of *Alpiscorpilus istanbulensis* sp. n. female holotype.

(6-7). Dorsal patellar spur poorly developed. Pedipalp femur is shorter than the patella. Carapace tends to be slightly wider than long. Chelae carinae  $V_1$  follows an internal direction to the trichobothria  $Et_1$ , to form a “Y” formation. Spinules on legs ending with a decentralized spinule. The metasomal segment V is mostly longitudinally rounded, and might have slight edging, like a trace of the ventral carinae but without more evident particular granulation on them; intercarinal spaces on the V segment may be very finely granulated to almost smooth.

#### Trichobothrial and pectinal teeth count variation

The variation observed in 140 examined specimens (82 ♂ and 58 ♀)

Pectinal teeth in males: 8/8 (7), 8/9 (10), 9/9 (56), 9/10 (8), 10/10 (1); in total, 8 in 14.63% (24), 9 in 79.27% (130) and 10 in 6.10% (10); average = 8.91.

Pectinal teeth in females: 5/6 (1), 6/6 (9), 6/7 (13), 7/7 (33); in total, 5 in 0.90% (1), 6 in 27.93% (31) and 7 in 71.17% (79); average = 6.70.

Pedipalp patella trichobothria  $Pv$ : 5/6 (7), 6/? (1), 6/6 (120), 6/7 (11), 7/7 (1); in total, 5 in 2.42% (7), 6 in 93.42%



**Figs 5-12.** *Alpiscorpius istanbulensis* sp. n. 5. Carapace and tergites I-IV of adult male. 6. Carapace and tergites I-IV of adult female. 7. Part of the ventral prosoma of adult male. 8. Part of the ventral prosoma of adult female. 9-12. Retrolateral aspect of tibia, basitarsus and tarsus of right legs (I-IV respectively).



**Figs 13-27.** *Alpiscorpius istanbulensis* sp. n. 13. Ventral view of chela. 14. Dorsal view of chela. 15. External view of chela of adult male. 16. External view of chela of adult female. 17. Dorsal view of pedipalp femur. 18. Ventral view of pedipalp femur. 19. External view of pedipalp patella. 20. Dorsal view of pedipalp patella. 21. Ventral view of pedipalp patella. 22. Telson of adult male. 23. Telson of adult female. 24. Metasoma of adult female. 25. Metasoma of adult male. 26. Dorsal view of metasomal segment V. 27. Lateral view of metasomal segment V.



**Fig. 28.** Female live specimen of *Alpiscorpius istanbulensis* sp. n.

(270), 7 in 4.15% (12); mean = 6.02.

Pedipalp patella trichobothria *Pe-et*: 3/4 (4), 4/4 (134), 4/5 (7), 5/5 (2), 1/4 (2), 4/? (1); in total, 3 in 0.33% (1), 4 in 94.31% (282), and 5 in 3.68% (11); average = 4.21;

*est* = 3/4 (3), 4/4 (101); *em* = 2/3 (6), 3/3 (98); *esb* = 2/2 (104); *eb<sub>a</sub>* = 4/4 (104); *eb* = 4/4 (104).

#### Description of the female holotype (Table 2)

**Colouration.** Brown, brown-reddish, with darker marbling more or less over the whole body, but weak or absent on pedipalp chelae; chelicerae, telson and legs have a light brown-orangish basal colouration with dark brown or blackish marbling; pectines and genital operculum whitish/ivory; the sternites are very light brownish, except the most distal, which is darker, with a similar colouration for metasoma.

**Carapace.** With very fine granulation; anterior edge with a few granules and more or less straight; posterior lateral, posterior median and anterior median furrows are present; two pairs of lateral eyes and a pair of median eyes, situat-

ed distally of the middle, are present; distance from centre of median eyes to anterior margin is 43.48% of carapace length.

**Mesosoma.** Tergites punctate. Spiracles small, oval shaped and inclined downward towards outside.

**Metasoma.** Dorsal carinae on segments I–IV granulated; ventrolateral carinae on segment I and IV absent or obsolete and smooth; ventromedian carina on segments I–IV absent; segment V is mostly longitudinally rounded, with slight edging as a trace of the ventral carinae without any particular granulation evident on them; dorsal intercarinal spaces on segments I–IV slightly granulated, the remaining parts mostly smooth, the V segment is very finely granulated.

**Telson.** Wider than high. Vesicle 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.** Formed by two subtriangular divided sclerites.

**Sternum:** Pentagonal shape, type 2; more or less as wide

**Table 2.** Measurements (mm) of *Alpiscorpius istanbulensis* sp. n.

	Paratype ♂	Holotype ♀	
Total	L	27.99	25.73
Carapace	L/PW	3.77/3.98	3.70/4.20
Metasoma	L	15.44	10.03
Segment I	L/W	1.49/1.70	1.30/1.71
Segment II	L/W	1.73/1.55	1.55/1.50
Segment III	L/W	1.92/1.50	1.70/1.50
Segment IV	L/W	2.24/1.44	2.10/1.40
Segment V	L/W	3.74/1.50	3.38/1.48
Telson	L	4.32	3.30
Vesicle	L/W	3.12/1.70	2.28/1.50
Aculeus	L/W	1.47/1.20	1.28/1.02
Femur	L/W	2.92/1.22	3.00/1.30
Patella	L/W	3.33/1.35	3.24/1.50
Chela	L/W	6.78/2.85	6.54/2.70
Movable finger	L	4.03	3.72

Abbreviations: L = length, W = width, PW = posterior width, H = height.

as long, deep posterior emargination.

**Pedipalps.** Coxa and trochanter with tuberculated carinae. Femur: dorsal and ventral internal carinae and dorsal external carinae tuberculated; ventral external carinae irregular; external median carinae with a few very low, serrulated tubercles; anterior median carinae formed by large, spaced and conical tubercles of similar size; intercarinal spaces with granules of different size. Patella: dorsal internal carinae tuberculated and crenulated; ventral internal carinae tuberculated and granulated; dorsal external carinae rounded and smooth; ventral external carinae is undulated and smooth; Ventral and external intercarinal surface smooth, dorsal and internal with very small granules. Dorsal patellar spur poorly developed. Chela: carina *D1* well distinct and smooth; *D4* obsolete; *V1* is distinctly strong, dark and smooth, but with about two or three tubercles proximally; *V3* obsolete but darker of the basal colour; intercarinal internal tegument granulated, the remaining parts from mostly smooth to reticulated; Finger dentition: in the most distal part is present a *DD* on the tip; *MD* is formed by very small denticles closely spaced forming a more or less straight line, discontinued at level of the *OD*; fixed finger has 6/6 *OD* and 10/11 *ID*; movable finger has 8/8 *OD* and 14/13 *ID* (broken finger tip).

**Trichobothria.** Chela: trichobothria on the pedipalp manus ventral surface  $V = 3/3 (V_{1-3}) + Et_1 = 1/1$ ; the trichobothrium  $V_4$  is situated on the external surface on the carina  $V_1$ ; the trichobothrium *et* on fixed finger is located distally to the notch of the fixed finger; *est* is located on centre to the notch; *et-est/est-dsb* ratio is about 2. Patella: ventral (*Pv*): 6/6; patella external (*Pe*): *et* = 4/4, *est* = 4/4, *em* = 3/3, *esb* = 2/2, *eb<sub>a</sub>* = 4/4, *eb* = 4/4. Femur: trichobothrium *d* on femur is slightly proximal to *i*, while the trichobothrium *e* is

distal to both, situated on dorsal external carina.

**Legs.** All right legs are missing; legs with two pedal spurs; no tarsal spur; ventral row of tarsus III with a total of 10 spinules of increasing size from proximal to distal; 3 larger flanking pairs of tarsal setae adjacent to the ventral spinules row are presents. Tubercles are absent on IV leg, while they are present on the other legs but in smaller number.

**Chelicerae.** Typical of the subfamily Euscorpiinae.

### Ecological notes

*Alpiscorpius istanbulensis* sp. n. were detected in three localities. Of these, the Agva and Aydos localities are a mixture forest composed of Hornbeam (*Carpinus* sp.), Red Pine (*Pinus brutia*) and Oak (*Quercus* sp.) trees. Polonezköy locality is composed of Hornbeam (*Carpinus* sp.) and Oak (*Quercus* sp.) trees. The trees are dense in all localities, and inside the forests it is cool and humid (Figs 29-30). The specimens were collected in Agva and Aydos under stones. It was observed that under stones it is humid or somewhat wet. The specimens were collected in Aydos in daytime inside of crevices in the soil walls, too. Specimens were collected in Polonezköy in night field trips. Along the path many specimens were observed on the surface, in crevices or under the bushes in the sitting position.

### Known geographic range

Istanbul Province (Fig. 31).

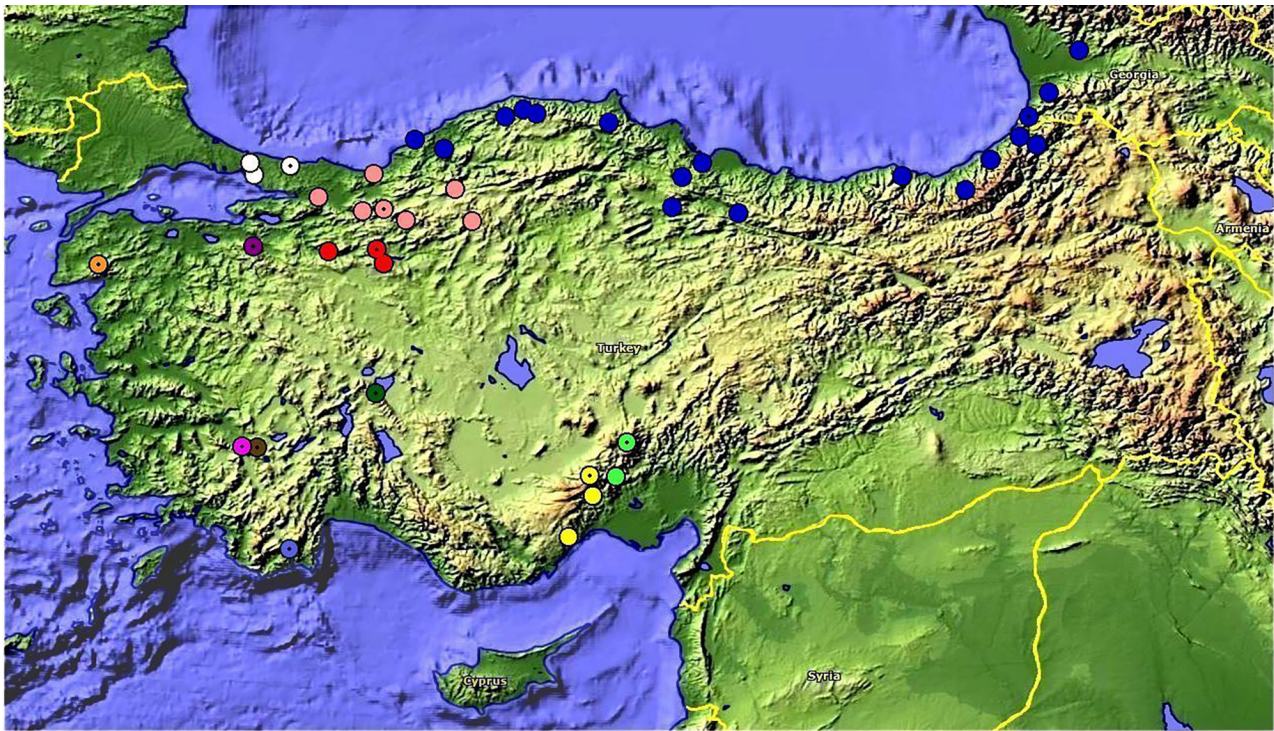
### Comparison with geographically close species

*Alpiscorpius istanbulensis* sp. n. is genetically well di-





Figs 29-30. Examples of *Alpiscorpius istanbulensis* sp. n. habitats.



**Fig. 31:** Distribution of the Euscorpiinae spp. relative to the genus *Alpiscorpius* Gantenbein et al., 1999 in Turkey. *A. istanbulensis* sp. n. (white), *E. idaeus* (orange), *E. aladaglarensis* (light green), *E. arikani* (light blue), *E. ciliciensis* (yellow), *E. eskisehirensis* (red), *E. hakani* (brown), *E. honazicus* (fuchsia), *A. mingrelicus* (blue), *A. phrygius* (pink), *E. sultanensis* (dark green), *A. uludagensis* (purple). The black dots in the circles indicate the type localities. The distribution of the species was taken from the following papers: Tropea and Yağmur, 2015, 2016a, 2016b; Tropea et al. 2015, 2016a; Yağmur and Tropea, 2015, 2017.

vided from all other species of Euscorpiinae (Table 3). Its genetic divergence is 7.4% in COI with *A. phrygius* (Bonacina 1980), while higher values were observed with the other species. Thus, its validity is beyond doubt. Regarding morphology and chaetotaxis, this species can be mainly distinguished from *A. uludagensis* (Lacroix, 1995) because the latter has  $Pv = 5$ . *A. istanbulensis* sp. n. can be distinguished from *A. mingrelicus* (Kessler, 1874) since the latter species

has the trichobothrial series  $Pe-et = 5$ , it is larger in size, and has different proportions. The new species can be divided from *Euscorpius eskisehirensis* Tropea et Yağmur, 2015 by the lower number of pectinal teeth, 8 in males and 6 to 7, mostly 6, in females, different proportions and lighter colour, light brown to medium brown-reddish, without marbling vs dark brown. The geographically closest species to *A. istanbulensis* sp. n. is *A. phrygius*, which shares with the new species

**Table 3.** Genetic divergence between *COI mtDNA* sequences. The number of base substitutions per site from between sequences is shown. Standard error estimate(s) are shown above the diagonal.

<i>E. stahlavskyi</i>	-	0,023	0,023	0,021	0,020	0,025	0,020	0,020	0,019	0,021	0,019
<i>E. alanyaensis</i>	0,158	-	0,015	0,027	0,022	0,021	0,015	0,020	0,019	0,020	0,022
<i>E. gocmeni</i>	0,147	0,079	-	0,021	0,020	0,024	0,020	0,021	0,017	0,023	0,020
<i>A. zloporubovici</i>	0,134	0,165	0,131	-	0,014	0,014	0,018	0,016	0,017	0,022	0,017
<i>A. cf. dinaricus</i>	0,132	0,153	0,129	0,067	-	0,018	0,016	0,018	0,017	0,023	0,018
<i>A. ypsilon</i>	0,152	0,136	0,149	0,071	0,083	-	0,017	0,022	0,015	0,020	0,018
<i>A. phrygius</i>	0,130	0,101	0,137	0,100	0,096	0,096	-	0,014	0,014	0,016	0,014
<i>A. mingrelicus</i>	0,127	0,133	0,144	0,084	0,104	0,123	0,074	-	0,015	0,020	0,015
<i>E. idaeus</i>	0,126	0,117	0,111	0,098	0,094	0,087	0,080	0,087	-	0,020	0,015
<i>E. eskisehirensis</i>	0,124	0,110	0,128	0,106	0,119	0,105	0,083	0,103	0,110	-	0,018
<i>A. istanbulensis</i>	0,128	0,136	0,124	0,088	0,100	0,102	0,074	0,078	0,087	0,093	-

A. = *Alpiscorpius*, E. = *Euscorpius*.

the trichobothrial and pectinal teeth number. However, *A. phrygius* is generally more granulated, has a usually lighter and reddish brown colour and the morphology of the chela, especially of the male, has an upper internal margin similar in shape to a lobe, which widens proximally and the fixed finger appears shorter, giving a stubbier appearance to the chela of this species, versus a more regular chela shape and a more slender finger in *A. istanbulensis* sp. n.

The closest *Alpiscorpius* species to the west is *Alpiscorpius pavicevici* Tropea, 2021 in Serbia (Tropea 2021). It has been located about 650 km away from *A. istanbulensis* sp. n., is smaller on average and has a lower number of *Dp*, 7-8 in males and 6-7 in females. Another specimen of *Alpiscorpius*, *A. cf. pavicevici*, was reported from the Pirin Mountains, in southwestern Bulgaria about 480 km from *A. istanbulensis* (Teruel et al. 2004, Tropea 2021). No other populations belonging to the genus *Alpiscorpius* or related to it are known between the Pirin Mountains and İstanbul.

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