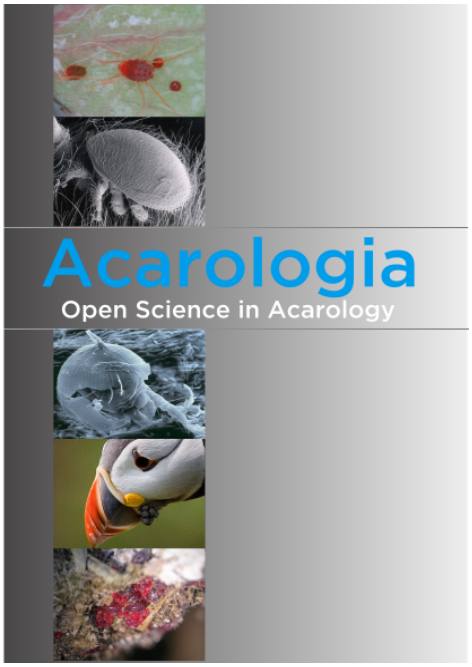


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Previous volumes (2010-2018): 250 € / year (4 issues)
Acarologia, CBGP, CS 30016, 34988 MONTFERRIER-sur-LEZ Cedex, France
ISSN 0044-586X (print), ISSN 2107-7207 (electronic)

The digitalization of Acarologia papers prior to 2000 was supported by Agropolis Fondation under the reference ID 1500-024 through the « Investissements d'avenir » programme (Labex Agro: ANR-10-LABX-0001-01)

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Acarologia 57(2): 369–382 (2017)
DOI: 10.1051/acarologia/20164162

Description of a new rake legged mite of the genus *Allocaeculus* (Acariformes: Caeculidae) from Turkey with description of variation in dorsal setation

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(Received 27 June 2016; accepted 21 October 2016; published online 04 April 2017; edited by Marie-Stéphane TIXIER)

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ABSTRACT — A new species *Allocaeculus turcicus* **n. sp.** (Acariformes: Caeculidae) is described based on specimens collected from Karanlıkdere Valley, Yozgat, Turkey. Some asymmetries and numerical variations of dorsal body setae of the new species are recorded. A list of the species of this genus is provided. In Turkey, this genus is recorded for the first time.

KEYWORDS — Acariformes; *Allocaeculus*; systematics; rediscovery; comparison; Turkey

ZOOBANK — 1B6D4FC6-6635-4481-ABB0-FCAB2766B56E

INTRODUCTION

The family Caeculidae (Acariformes: Trombidiformes) is composed of relatively large (1000 – 3000 μm) and strongly sclerotized mites. They are found worldwide in drier habitats and are free-living and usually predaceous (Hagan 1985; Otto 1993; Walter *et al*. 2009; Taylor *et al*. 2013; Taylor 2014; Mangová *et al*. 2014), though laboratory experiments have demonstrated that *Caeculus crossleyi* Hagan, 1985 successfully feeds and reproduces in cultures containing fungal hyphae (Crossley and Merchant 1971; Hagan 1985).

Adults of Caeculidae characteristically bear eight heavily sclerotized dorsal plates. They are commonly referred as rake-legged mites due to the presence of elongate spine like setae on the legs, particularly the first pair. These spines are used in the capture of small arthropods such as collembolans (Otto 1993; Walter *et al*. 2009; Taylor *et al*. 2013; Taylor 2014).

Extensive studies on this family were published by Franz (1952, 1954, 1955, 1957, 1960, 1962, 1964, 1965), Coineau (1967a, b, 1968, 1969a, b, 1974a, b), Coineau and Enns (1969), Coineau and Haupt (1977), Coineau and Magowski (1994), Coineau and Poinar (2001), and a recent list of all species of the family has been provided by Taylor *et al*. (2013). At the present time, this family consists of about 100 species within seven genera (Hallan 2005; Zhang *et al*. 2011; Taylor *et al*. 2013; Mangová *et al*. 2014). The genus *Allocaeculus* Franz, 1952 is the most diverse in the family with 34 described species (Table

TABLE 1: A list of known species of the genus *Allocaeculus* Franz, 1952

1	*Allocaeculus andalusiacus* Franz, 1952 [Spain]
2	*Allocaeculus catalanus* Franz, 1954 [Spain]
3	*Allocaeculus circinatus* Coineau, 1974 [Namibia]
4	*Allocaeculus dubius* (Kulczyński, 1901) [Algeria]
	[=*Caeculus dubius* Kulczyński, 1901]
5	*Allocaeculus echinatus* Franz, 1952 [Spain]
6	*Allocaeculus erinaceus* Coineau, 1974 [South Africa]
7	*Allocaeculus grandjeani* Franz, 1957 [Morocco]
8	*Allocaeculus hirsutus* Coineau, 1974 [South Africa]
9	*Allocaeculus hoggarensis* (André, 1936) [Algeria]
	[=*Caeculus hoggarensis* André, 1936]
10	*Allocaeculus hystriciformis* Franz, 1952 [Spain]
11	*Allocaeculus hystrix* (Lawrence, 1939) [South Africa]
	[=*Caeculus hystrix* Lawrence, 1939]
12	*Allocaeculus indicus* Piffl, 1959 [Pakistan]
13	*Allocaeculus kalahariensis* Coineau, 1974 [South Africa]
14	*Allocaeculus kenyae* Franz, 1964 [Kenya]
15	*Allocaeculus kocheri* Franz, 1964 [Morocco]
16	*Allocaeculus logonensis* Franz, 1957 [Chad]
17	*Allocaeculus meseticola* Franz, 1952 [Spain]
	[=*Caeculus meseticola* Franz, 1952]
18	*Allocaeculus mosambicensis* (André, 1936) [Mozambique]
	[=*Caeculus mossambicensis* André, 1936]
19	*Allocaeculus multispinosus* Franz, 1955 [Spain]
20	*Allocaeculus nigeriensis* Coineau, 1974 [Nigeria]
21	*Allocaeculus ouadaiensis* Franz, 1957 [Chad]
22	*Allocaeculus pilosus* (Lawrence, 1938) [Namibia]
	[=*Caeculus pilosus* Lawrence, 1938]
23	*Allocaeculus relictus* Franz, 1952 **TYPE SPECIES** [Austria]
24	*Allocaeculus sandbergensis* Mangova, Krumpal & Luptacik, 2014 [Slovakia]
25	*Allocaeculus sarhroi* Franz, 1964 [Morocco]
26	*Allocaeculus schusteri* Franz 1960 [Macedonia]
27	*Allocaeculus sclerodermatus* (André, 1936) [Tunisia]
	[=*Caeculus sclerodermatus* André, 1936]
28	*Allocaeculus sculptus* (Karpelles, 1893) [Italy]
	[=*Hoplopus sculptus* Karpelles, 1893]
	[=*Caeculus sculptus* Karpelles, 1893]
29	*Allocaeculus senegalensis* (André, 1938) [Senegal]
	[=*Caeculus senegalensis* André, 1938]
30	*Allocaeculus spathulifer* (Michael, 1890) [Algeria]
	[=*Caeculus spathulifer* Michael, 1890]
31	*Allocaeculus spinosissimus* Franz, 1952 [Spain]
	[=*Allocaeculus spinosissimus rondae* Franz]
32	*Allocaeculus sudanensis* (Trägardh, 1905) [Sudan]
	[=*Caeculus sudanensis* Trägardh, 1905]
33	*Allocaeculus tenerifae* Franz, 1965 [Spain]
34	*Allocaeculus tschadensis* Franz, 1957 [Chad]
	[=*Allocaeculus tschadensis rifensis* Franz, 1960]

1). *Allocaeculus* spp. are easily recognizable by the anterior half of the prodorsal sclerite being extensively neotrichous, unequal tarsal claws of leg I, and by the absence of dorsodistal bothridia *bt* on legs I and II (Taylor *et al*. 2013).

In this paper, the species *Allocaeculus turcicus* **n. sp.** from Karanlıkdere Valley, Turkey is described. In order to contribute to the knowledge of mites in Turkey, a faunistic study was carried out in Karanlıkdere Valley during 2013-2014. We also intend to demonstrate variation in dorsal setation of the new species. Finally a list of species of this genus and the countries where they have been reported is provided.

Materials and methods

Samples obtained from mosses on the rock in Karanlıkdere Valley, Yozgat were put in plastic bags. Mites were extracted using a Berlese funnel apparatus in the laboratory. They were preserved in 70 % ethanol, cleared in 50 % lactic acid for a few hours and then mounted on microscope slides in modified Hoyer's medium. All measurements were done with ocular micrometer attached to a compound microscope (Olympus CX21) and given in micrometers (μm). Measurements of the holotype are given first; those of paratypes are in brackets. Specimens studied with SEM were cleaned by soaking in Terg-a-zyme solution for 2 h. After air-drying, samples were glued onto aluminium holders and coated with 180 A° of AuPd prior to photography. The terminology used is based on Franz (1952) and Mangová *et al.* (2014).

Family Caeculidae Berlese, 1883
Genus *Allocaeculus* Franz, 1952

Type species: ***Allocaeculus relictus*** Franz, 1952: 111, by original designation.

Diagnosis — Prodorsal plate covers the rostrum wholly or mostly; two pairs of ocelli present on prosoma; idiosoma long oval or rentangular in shape; legs with tridactylous.

Allocaeculus turcicus n. sp.
(Figures 1-9)

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Material examined — Holotype: Adult (♀), from Karanlıkdere Valley, Yozgat, Turkey, 844 m, 39°34.762'N, 34°38.902'E, mosses on the rock, 14 September 2013. Paratypes: Five adults (♀), from the same locality as the holotype. The types are deposited in the Acarological collection of the Zoology Museum, Bozok University, Yozgat, Turkey (Holotype No. BUZM-2016-1, Paratypes No. BUZM-2016-2-6).

Description Female (Holotype) — Length of body 1450 (1350 – 1575), width 850 (810 – 1000). Dorsum with 1 prodorsal and 5 hysterosomal plates. Integument between middle hysterosomal plate and the lateral plates longitudinally wrinkled. Setae *Pa* present in the anterior of prodorsal plate. The bothridial setae (*bo*) fusiform, with barbed (Figure 9E). Prodorsal plate bearing 14 pairs of setae (*p*) (10-14 pairs in the paratypes), first 6 pairs (*p1-p6*) thickened and arch shaped, 95 in length (Figures 1A, C, 2, 5A).

Two pairs of eyes situated on optical tubercle on prosoma (Figures 1A, C, 9A). Ocular setae absent. Middle hysterosomal plate 630 (510-680) long and 390 (350-480) wide, bearing 8 conic setae (*h*), (8-12 pairs in the paratypes), about 80 in length. Sixth pair of seta (*c1*) slightly widened, 95 in length (Figures 1C, 5A). Lateral plates rectangular, 660 long and 170 wide, bearing 18 setae (*h'*), (Figures 1C, 5A) (ranging in number of seta *h'* from 14 to 22 in the paratypes). Setae *a2* and *c2* 120 and 135 in length, respectively (Figures 1C, 5A). First caudal plate collapsed in the middle part, ten pairs of setae (*k*) on the inferior edge (ranging from 9-13 in the paratypes), about 45 in length and third (*d3*) and eighth (*d2*) pairs 95 in length (Figures 1E, 5A). Second caudal plate oblong, its inferior edge with 10 setae (*k'*) in left, 11 in right (8-13 in the paratypes), about 45 in length. In left, third (*e2*) and seventh (*e1*) pairs, 80 in length. In right, fourth (*e2*) and ninth (*e1*) pairs, 80 in length (Figures 1E, 5A).

Venter with 4 coxisternal plates and strongly sclerotized genital and anal plates. Epimeres I and

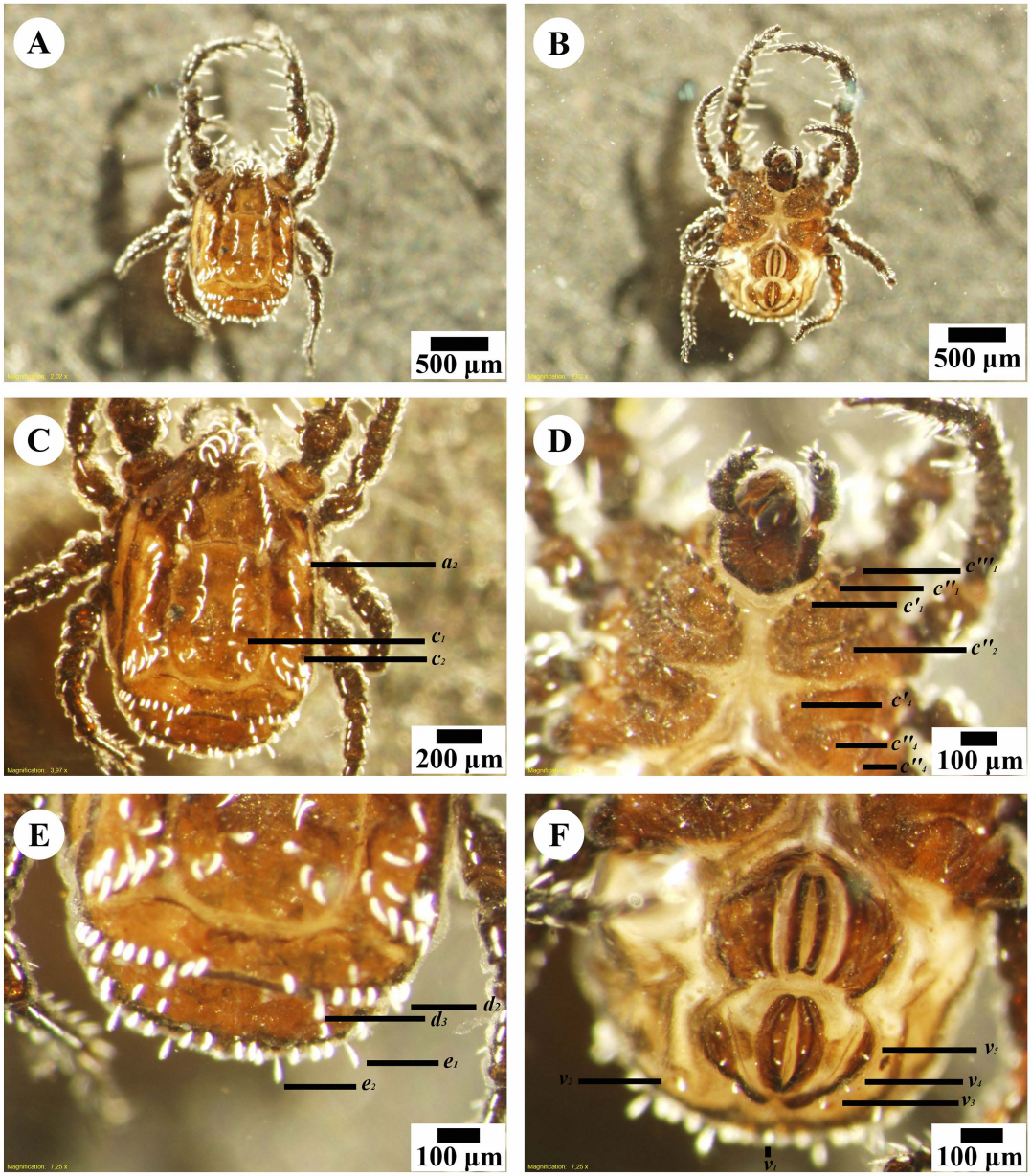


FIGURE 1: *Allocaeculus turcicus* **n. sp.** (holotype): A – Dorsal view; B – Ventral view; C – The middle hysterosomal and the lateral plates; D – Epimeral region; E – The first and the second caudal plates; F – Genital and anal region.

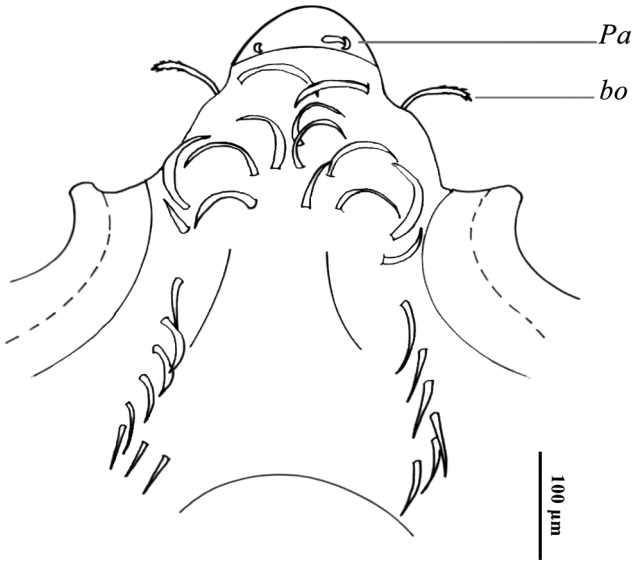


FIGURE 2: *Allocaeculus turcicus* **n. sp.** (holotype). Prodorsal plate

II fused, epimere I with 3 pairs of clubbed setae (*c′1*, *c″1*, *c‴1*), about 60 in length, epimere II with 3 pairs of clubbed setae (*c′2*, *c″2*, *c‴2*), about 35 in length. Epimeres III and IV fused, epimere III with 2 pairs of clubbed setae (*c′3*, *c″3*), about 40 in length, epimere IV with three pairs of clubbed setae (*c′4*, *c″4*, *c‴4*), 35 in length. Ten pairs of aggenital setae present, 4 pairs of setiform setae situated on aggenital sclerites; anteriormost pair of clavate aggenital setae *ag1* situated close to level of anterior of primere IV; 2 pairs of setiform setae situated directly anterior to aggenital sclerites; 2 pair of setae situated lateral to aggenital sclerites; 1 pair of setae situated posterior to aggenital sclerites. Genital plate length 270 (210-270), width 150 (120-200). Six pairs of setae on genital plate present and about 30 in length. Distance between genital and anal plates 50. Anal plates length 240, width 160. Three pair of setae on anal plate present. Four pairs of adanal setae present, with 3 pairs of setiform setae (*v3*, *v4*, *v5*) on adanal sclerites. One non-conjugated seta *v1* situated on posterior margin of ventral hysterosoma (Figures 1B, D, F, 6A).

Pedipalps short and thick, 250 in length. Palptibia three long claws, about 40 in length, Pointed seta *s* situated anteriorly on palptibia. Palptarsus three short seta *o* and one pointed seta *s*. Genu with a long seta *r*, directed anteriorly. Femur with one clubbed setae *q* ventrally, 50 in length and three clubbed seta dorsally q_1-q_3 (Figure 9F, G).

Leg I with robust 9 spines and 1500 in length. Leg I ending in 2 tarsal claws (*cl*), 70 in length. Spines *t* situated anteriorly on tarsus, and 50 in length. Metatarsus bearing 3 spines (*c*, *c*, *a*) anteriorly (190, 190 and 170 in length, respectively), conic setae *m* situated anterodorsally (65 in length), posteriorly (80 in length). Tibia with 2 spines (*d*, *c*) anteriorly (220 and 170 in length, respectively), setae *m* situated anterodorsally (60 in length), posteriorly (75 in length), setae *t* situated anterodorsally (25 in length). Genu bearing 1 spine (*b*) anteriorly (180 in length), setae *m* situated posteriorly (85 in length), seta *t* anterodorsally (15 in length). Femur with 1 spine (*b*) anteriorly (150 in length), setae *m* situated posteriorly (95 in length), clubbed seta *y* situated anterodorsally (90 in length). Trochanter bearing 2 spines (*b*, *b*) anteriorly (150 and 140 in length), setae *y* situated posterodorsally (115 in length), an-

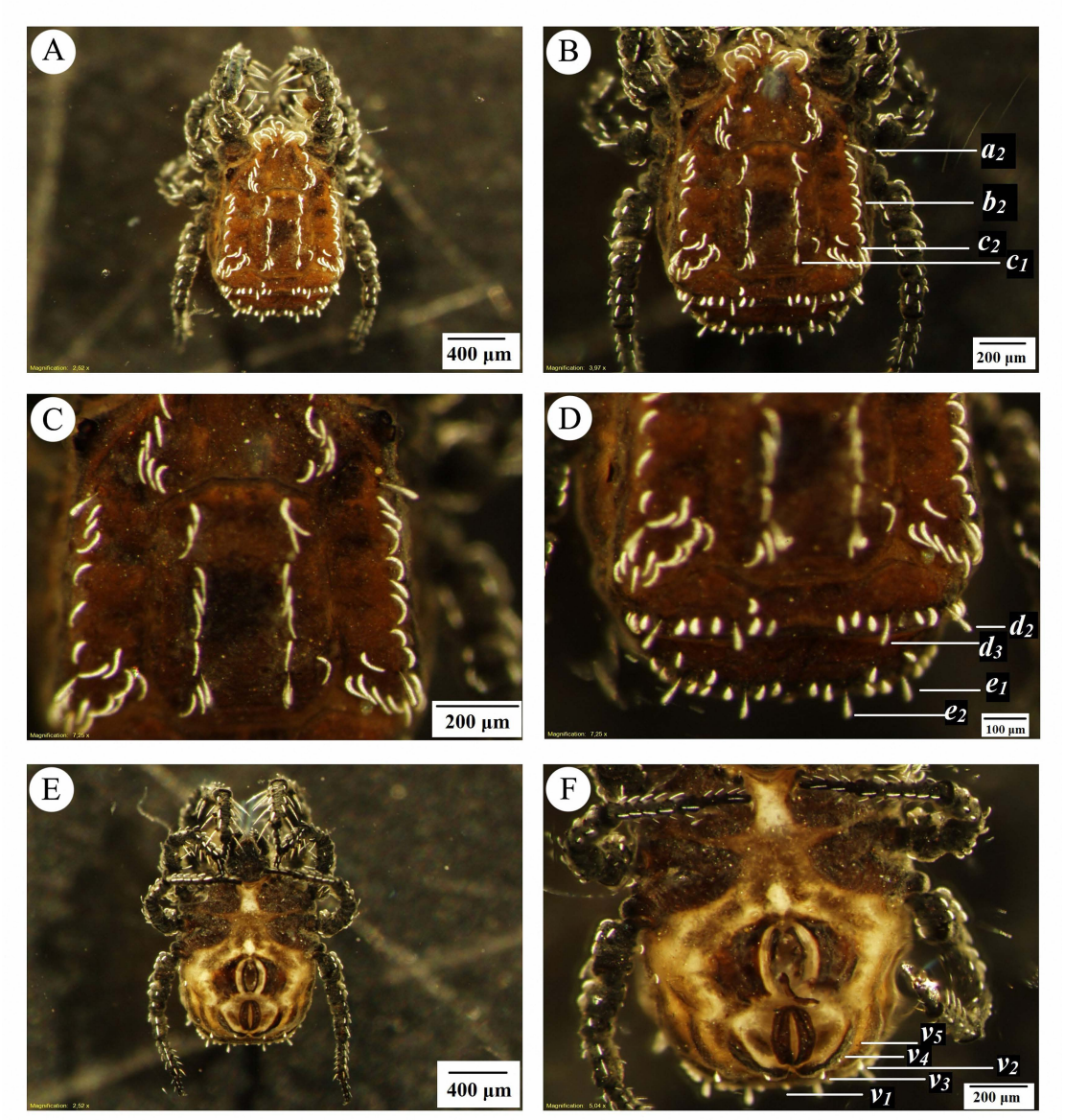


FIGURE 3: *Allocaeculus turcicus* **n. sp.** (paratype): A, B – Dorsal view; C – The middle hysterosomal and the lateral plates; D – The first and the second caudal plates; E – Ventral view; F – Genital and anal region.

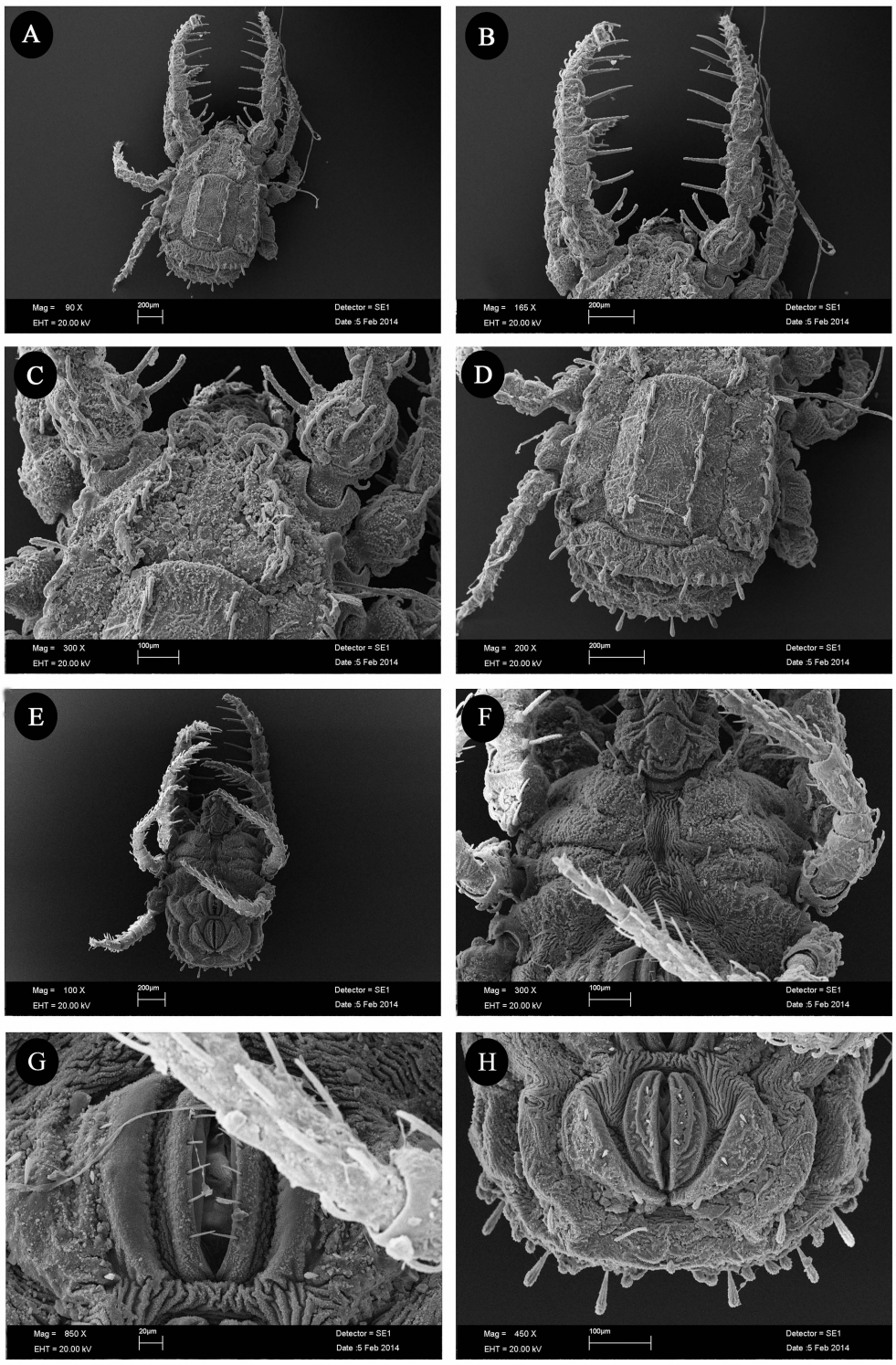


FIGURE 4: *Allocaeculus turcicus* **n. sp.** (paratype): A – Dorsal view; B – leg I; C – Prodorsal region; D – Dorsal hysterosoma; E – Ventral view; F – Epimeral region; G – Genital region; H – Anal region.

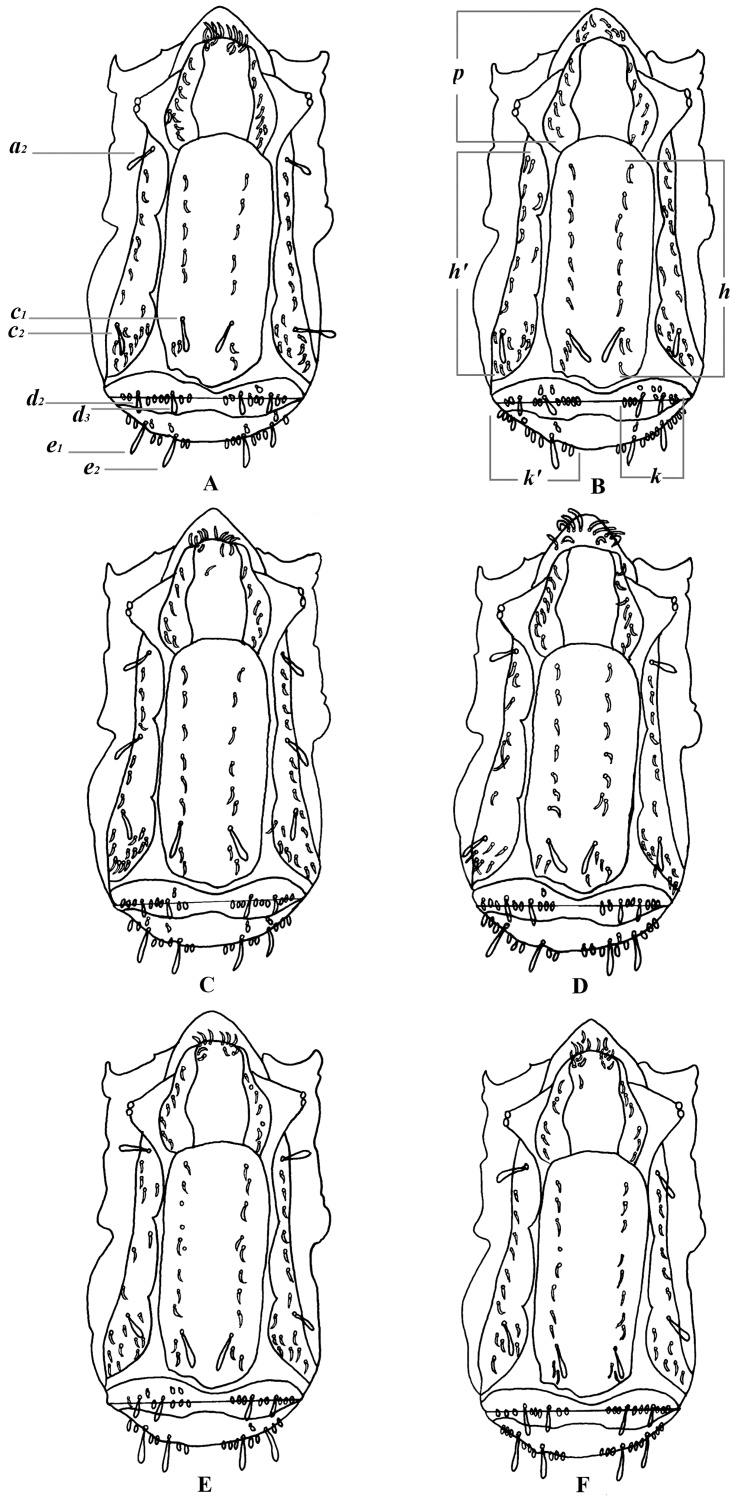


FIGURE 5: *Allocaeculus turcicus* **n. sp.** Variations in the chaetotaxy: A – Dorsal view of holotype; B-F – Dorsal view of paratypes.

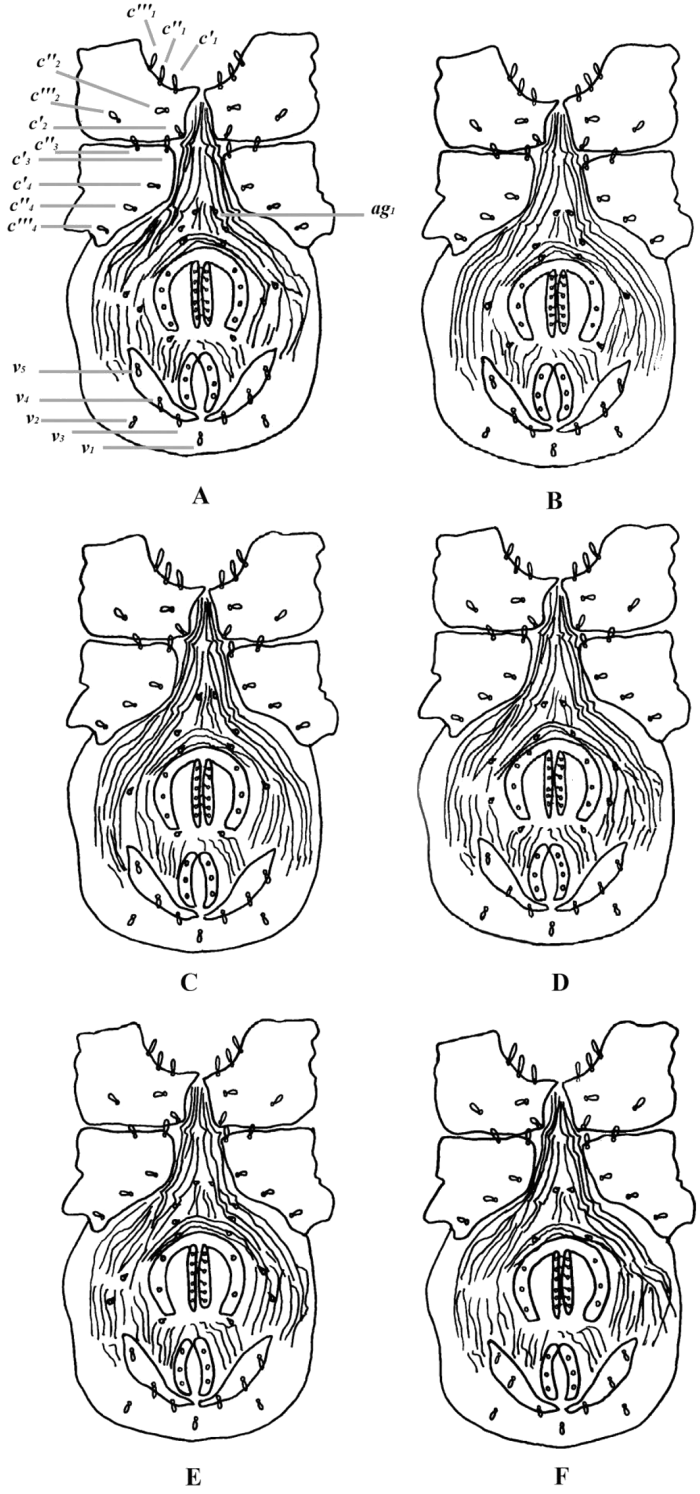


FIGURE 6: *Allocaeculus turcicus* **n. sp.** Variations in the chaetotaxy: A – Ventral view of holotype; B-F – Ventral view of paratypes.

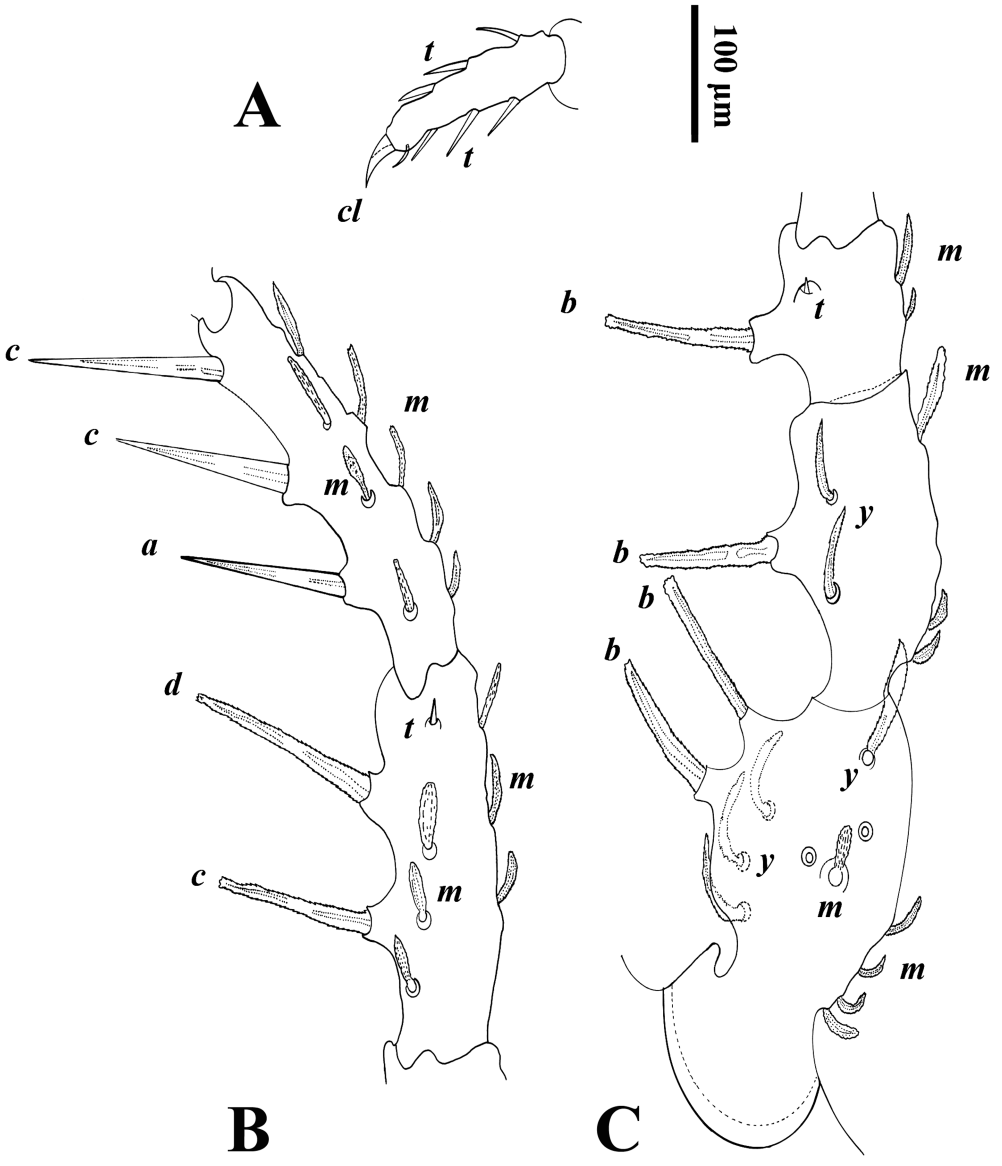


FIGURE 7: *Allocaeculus turcicus* **n. sp.** (holotype): A – tarsus I, dorsal view; B – Leg I, tibia and metatarsus, dorsal view; C – Leg I, trochanter to genu, dorsal view.

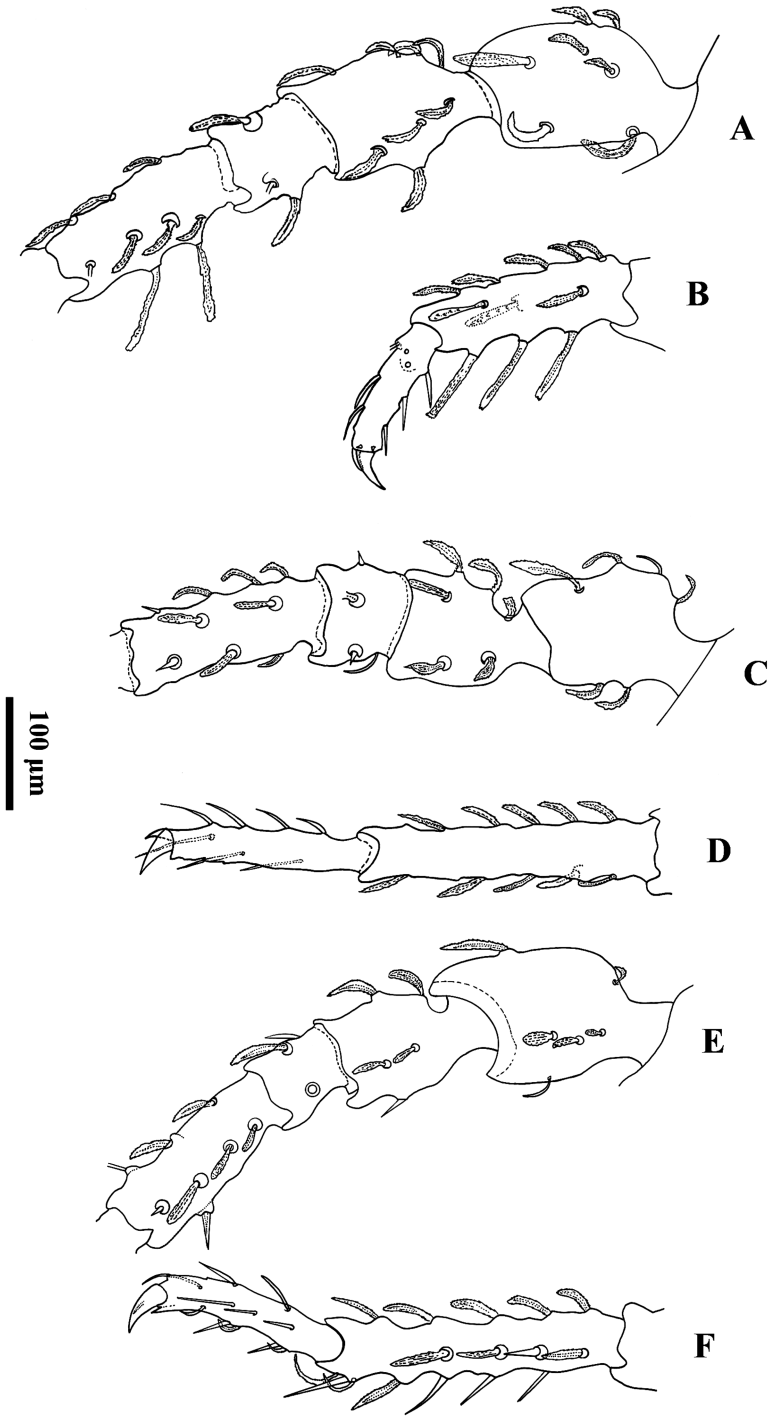


FIGURE 8: *Allocaeculus turcicus* **n. sp.** (holotype): A – Leg II, trochanter to tibia, dorsal view; B – Leg II, metatarsus and tarsus, dorsal view; C – Leg III, trochanter to tibia, dorsal view; D – Leg III, metatarsus and tarsus, dorsal view; E – Leg IV, trochanter to tibia, dorsal view; F – Leg IV, metatarsus and tarsus, dorsal view.

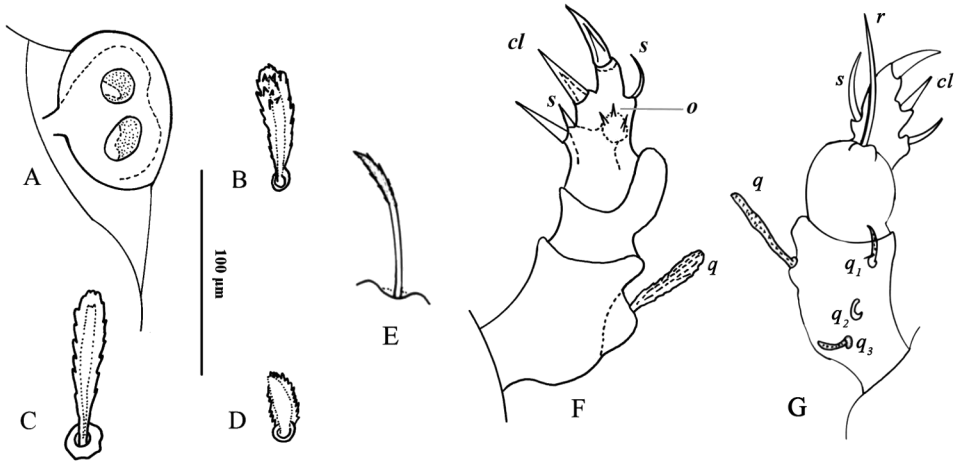


FIGURE 9: *Allocaeculus turcicus* **n. sp.** (holotype): A – Right eyes; B – Broaden seta in caudal plate; C – Broaden seta in the middle hysterosomal plate; D – Clubbed seta in caudal plate; E – Bothridial setae; F – Left pedipalp, ventral view; G – Left pedipalp, dorsal view.

teroventrally (80 in length), setae *m* situated posterodorsally (50 in length), posteriorly (45 in length) (Figure 7). Legs II - IV 1125, 1125 and 1150 long, respectively and ending by tarsal claws 40, 50, and 50 long, respectively (Figure 8).

Male and immature stages — Unknown.

Etymology — The name of this new species, *turcicus*, refers to the country in which it was found.

Differential diagnosis — The new species resembles *A. relictus* Franz, 1952, *A. catalanus* Franz, 1954, *A. indicus* Piffl, 1959 and *A. sandbergensis* Mangova, Krumpal and Luptacik, 2014 because dorsum has one prodorsal and five hysterosomal plates, and setae *c1*, *e2, e1* are present. The new species differs from *A. relictus*, *A. catalanus*, *A. indicus* and *A. sandbergensis* by the following features. In the new species, seta *a'2* is absent (present in *A. catalanus* and *A. sandbergensis*), setae *c1* single (double in *A. relictus*), epimeral setal formula is 3-3-2-3 (4-2-3-3 in *A. indicus*, 3-2-2-2 in *A. sandbergensis*), the adanal sclerites bear three pairs of setae each (five pairs in *A. relictus*, four pairs in *A. indicus*, one pair in *A. sandbergensis*), seta *v1* present (absent in *A. relictus* and *A. sandbergensis*).

Remarks — To date, this family was recorded in Turkey only once and from a single locality (Karaca *et al.* 2012). Observations showed that this new species has some asymmetry and numerical variations in dorsal body setae. All these cases are summated in Table 2. In the family Caeculidae, variations have been observed by some authors (Enns 1958; Otto 1993; Taylor *et al.* 2013). Variation in dorsal setation on *Neocaeculus imperfectus* Taylor, Gunawardene and Kinnear, 2013 was reported by Taylor *et al.* (2013). They also stated that those variations in ventral and leg setations are common within this species. Detailed discussion of patterns of variation in setation within and between Ceaculid species was provided by Coineau (1974a). The possible reasons of such variation are unknown and its significance for taxonomy not estimated. There are no organisms without variations. Adaptations to different environmental conditions of organisms lead to variations in genetic and phenetic terms. Organisms adapt to environment conditions such as temperature, humidity, amount of nutrients, pH, sunlight and radiation, which can cause genetic and phenetic differentiation and intraspecific variation.

In the present work we listed the 34 valid species of the genus *Allocaeculus* and the countries where they have been found (Table 1). Because of absence of specific key for the species of this genus, this check-list will be useful as a first step for the elaboration of such a tool. The first standard key to the

TABLE 2: Some variations in number of dorsal body setae of *Allocaeculus turcicus* **n. sp.**

	A		B		C		D		E		F	
seta	left plate	right plate	left plate	right plate	left plate	right plate	left plate	right plate	left plate	right plate	left plate	right plate
p	14	14	10	10	12	12	13	13	12	12	14	13
h	8	8	11	11	9	9	10	12	12	11	11	11
h'	18	18	21	19	22	20	15	18	19	19	14	13
k	10	10	13	11	11	11	11	9	10	10	10	11
k'	10	11	12	13	11	11	10	11	8	10	11	11
c_1	+	+	+	+	+	+	+	+	+	+	+	+
a_2	+	+	-	-	+	+	+	+	+	+	+	+
b_2	-	-	-	-	+	+	-	-	-	-	-	-
c_2	+	+	+	+	+	+	+	+	+	+	+	+
d_2	+	+	+	+	+	+	+	+	+	+	+	+
d_3	+	+	+	+	+	+	+	+	+	+	+	+
e_1	+	+	+	+	+	+	+	+	+	+	+	+
e_2	+	+	+	+	+	+	+	+	+	+	+	+

A: Holotype, B-F: Paratypes, + present, - absent.

species of this genus was developed by Franz (1952) who included 13 species. In the later years (1955) and (1957) he provided the keys for 9 and 10 species respectively, most of them were also included in the previous key. Untill now, no key apart from those has not been elaborated. The recent increase in the number of described species stresses thus the urgency of species key for this genus.

ACKNOWLEDGEMENTS

We are grateful to Christopher Taylor, Department of Environment and Agriculture Curtin University, Australia, for reading an earlier draft of the manuscript, to Yves Coineau, Marc De Meyer, Myriam Vandenbosch, Didier Van Den Spiegel and to Veerle Taekels for supplying of some papers. Also we would like to thank the employees of the Technology Research and Developing Centre of Erciyes University for the processing of the SEM photographs of the specimens. This study was supported by the Scientific Research Fund of Bozok University, research project no. 2013FEF/A56.

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