

Morphological study on a new opilionid species recorded from Turkey: *Paranemastoma karolianus* sp. n. (Opiliones: Nemastomatidae)

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터키산 통거미 신종의 형태학적 연구: *Paranemastoma karolianus* sp.

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ABSTRACT: In this study, a new opilionid species of *Paranemastoma* Redikorzevi, 1936 is described from northern Turkey. Fine structures of extremities, dorsal integument and genitalia of *Paranemastoma karolianus* sp. n. are presented. Differences between the new species and related species are discussed.

Key words: *Paranemastoma*, New species, Nemastomatidae, Opiliones, Turkey

초록: 본 연구에서는 북부 터키에서 *Paranemastoma*속의 통거미 1신종을 기재하였다. 본 종 *Paranemastoma karolianus*의 다리, 등면 표피 및 생식기의 미세구조를 제시하였다. 본 신종과 유사종과의 구별점에 대하여 고찰하였다.

검색어: *Paranemastoma*, 신종, 장님거미목, 통거미목, 터키

As in other arthropods, fine structures of taxonomic characters of arachnids taken by scanning electron microscopy (SEM) take part increasingly and remarkably in the identification keys (Bayram et al., 2011; Çorak Öcal et al., 2014; Yiğit and Benli, 2009; Yiğit et al., 2006, 2007a-c, 2009). In opilionoids, taxonomic characteristics such as protuberance, cuticle, setae and spines on prosoma and ophistosoma have been examined using both SEM and light microscopy for a definite identification. Such studies are needed to gain an understanding of functional anatomy and morphology of these animals. In this sense, several researchers emphasized ultrastructure of external morphology,

fine structure of setae, anatomy of ovipositor and penis in opilionids (Murphree, 1988; Schwendinger and Martens, 2002; Spicer, 1987). In the last decade, an electron microscopic studies were performed on opilionids in order to emphasize use of the structural features in taxonomy (Yiğit et al., 2007b).

There are some faunistic studies on the Balkan, Caucasian and Mediterranean countries (Martens, 2006; Cokendolpher, 1990; Snegovaya, 1999, 2004, 2008; Mitov, 2002; Mitov and Stoyanov, 2004). In Turkey, studies on opilionids are still insufficient, and they are mostly related to fauna (Çorak, 2004; Bayram and Çorak, 2007; Çorak and Bayram, 2007; Çorak et al., 2008; Kurt et al., 2008a-b, 2010, 2013; Bayram et al., 2010; Çorak Öcal et al., 2014).

Until now, 72 species were recorded from different regions of Turkey. 13 species and one subspecies belonging to

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Nemastomatidae were recorded in Turkey. These species are *Histicostoma caucasicum* (Redikorzevi 1936), *Giljarovia turcica* Gruber 1976, *Giljarovia tenebricosa* (Redikorzevi 1936), *Mediostoma ceratocephalum* Gruber 1976, *Mitostoma gracile* (Redikorzevi 1936), *Nemastoma bidentatum* Roewer 1914, *Nemastoma bidentatum sparsum* Gruber and Martens 1968, *Nemastoma anatolicum* Roewer 1962, *Paranemastoma superbum* Redikorzev 1936, *Paranemastoma werneri* (Kulczynski 1903), *Paranemastoma kalischevskyi* (Roewer 1951), *Pyza anatolica* (Roewer 1959), *Pyza taurica* Gruber 1979, *Vestiferum alatum* Martens 2006. So, only three paranemastomic species are known from Turkey till now.

In the present study, fine structures of extremities, dorsal integument and genitalia of *Paranemastoma karolianus* sp. n. are given. Diagnostic characters of the new and related species are discussed.

Materials and Methods

A total of 13 males and 5 females of *Paranemastoma karolianus* were examined. They were collected from litter in beech (*Fagus* sp.), pine (*Pinus*) and mixed forest in Kastamonu/Tosya (41° 0' N - 34° 03' E) Çankırı/Ilgaz (40°55'33" N - 33°37'39" E) and Trabzon/Sümela (40°41'31" N - 39°39'28" E) in Turkey (Map 1). The keys of Mitov and Stoyanov (2004), Snegovaya (1999), Martens (2006) and Schönhofer (2013) were used. Routine preparation techniques were used for SEM, and microphotographs were made with JEOL JSM-5600 in the

University of Kırıkkale. The stereo microscopic examination was carried out with NIKON SMZ-800, and micrographs were obtained by a camera attachment. All materials were deposited in the Zoological Research Laboratory in the University of Çankırı Karatekin.

Paranemastoma karolianus sp. n. (Figs. 1-4)

Identification key for males

- 1a. Four remarkable thorns in two rows on scutum; basal segment of chelicera with a hemispherical ledge, tip of penis thud and thick *P. superbum*
- 1b. Dorsal protrusions in different numbers and shapes; basal segment of chelicera and tip of penis different .. 2
- 2a. Eight small tubercles in two rows on scutum; basal segment of chelicerae with a small spur; tip of penis short, a bit pointed, neck narrower *P. kalischevskyi*
- 2b. Eight horn like protrusions in two rows on scutum; basal segment of chelicera with a remarkable hump, tip of penis long, pointed and hook like
..... *Paranemastoma karolianus*

Material. Holotype 1♂, "TR. Kastamonu, Tosya, 1 km W, Beech (*Fagus*) Forest, under debris in a moist habitat, 780 m, 41°01'N, 34°03'E, 17.VII.2006, leg. Bayram. Allotype 1♀, "Çankırı, Ilgaz Mountainside, Pine (*Pinus*) Forest, 70 km N, 15.VII.2007, leg. Çorak. Paratypes 4♂♂, Tosya, the same habitat with the holotype, 17.VII.2006, leg. Bayram; 3♂♂, Çankırı, Ilgaz Mountainside, the same habitat with the



Map. 1. Distribution of *Paranemastoma karolianus* in Turkey and the locality of the specimens. 1: Kastamonu/ Tosya (41°0' N - 34°03' E); 2: Çankırı/Ilgaz (40°55'33" N - 33°37'39" E); 3: Trabzon/Sümela (40°41'31" N - 39°39'28" E).

allotype, 15.VII.2007, leg. Çorak; 5♂♂, 4 ♀♀, Trabzon, Sümele Monastery, Forest (mixed), 23.VII.2008, leg. Çorak, Bayram and Sancak.

Etymology. The species is named in honour of the first Turkish arachnologist, (Mrs) Prof. Dr. Sevinç KAROL.

Diagnosis. Males of the new species differ from all other congeners by presence of four pairs of horn like tubercles on the scutum, a remarkable hump on the basal segment of the chelicerae, and being tip of the penis long, hook like and pointed.

Description. Male (holotype). Total length of body 3.5 mm (excluding legs), carapace width 2.1 mm. Total length of leg II 14.4 mm. Leg formula II, IV, I, III (Table 1). On dorsum there are eight protrusions, arranged in two rows (Fig. 1A). Each protrusion bears a big thorn (B). Dorsal integument has grain and gross granular structure, do not carry hairs or spines (B, C). Ocularium placed on posterior-median of propeltidium. Ocularium bears a pair of simple eyes directed sideways, and denticle rows around the eyes (C, D).

The chelicerae consist of a basal segment, a distal segment

Table 1. Leg measurements (mm) of *Paranemastoma karolianus* sp. n. (♂, ♀).

♂ (holotype)						
Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.1	0.5	1.3	2.5	2.2	8.6
II	3.2	0.6	2.1	5	3.5	14.4
III	2.2	0.4	1.2	2.4	2.3	8.5
IV	3	0.4	1.5	4.3	2.5	11.7
♀ (allotype)						
Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	2.8	0.7	1.6	3.2	2.7	11
II	3.9	1.1	2.4	6.8	4.1	18.3
III	3	0.8	1.5	4.1	2.5	11.9
IV	3.5	0.8	1.8	5	3.1	13.2

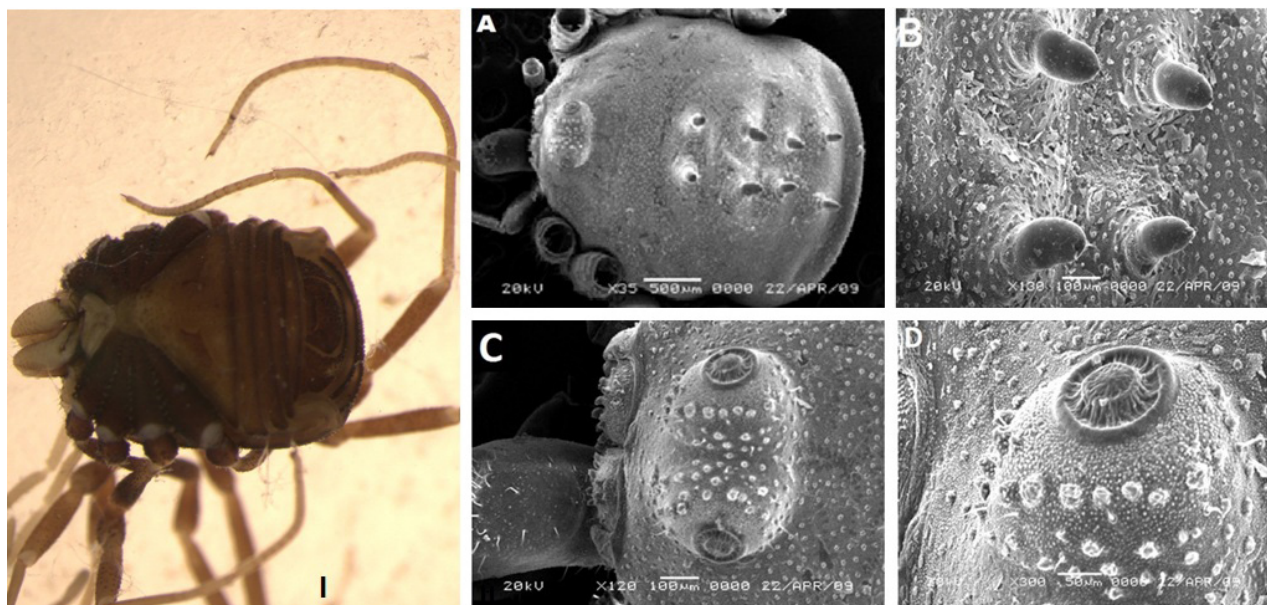


Fig. 1. *Paranemastoma karolianus* male (holotype). I: View of ventral side (by stereo microscope); A: Ocularium and protrusions on dorsum and view of dorsal side; B: Protrusions with thorns (by stereo microscope); C: Eyes on ocularium; D: Denticle rows around eyes.

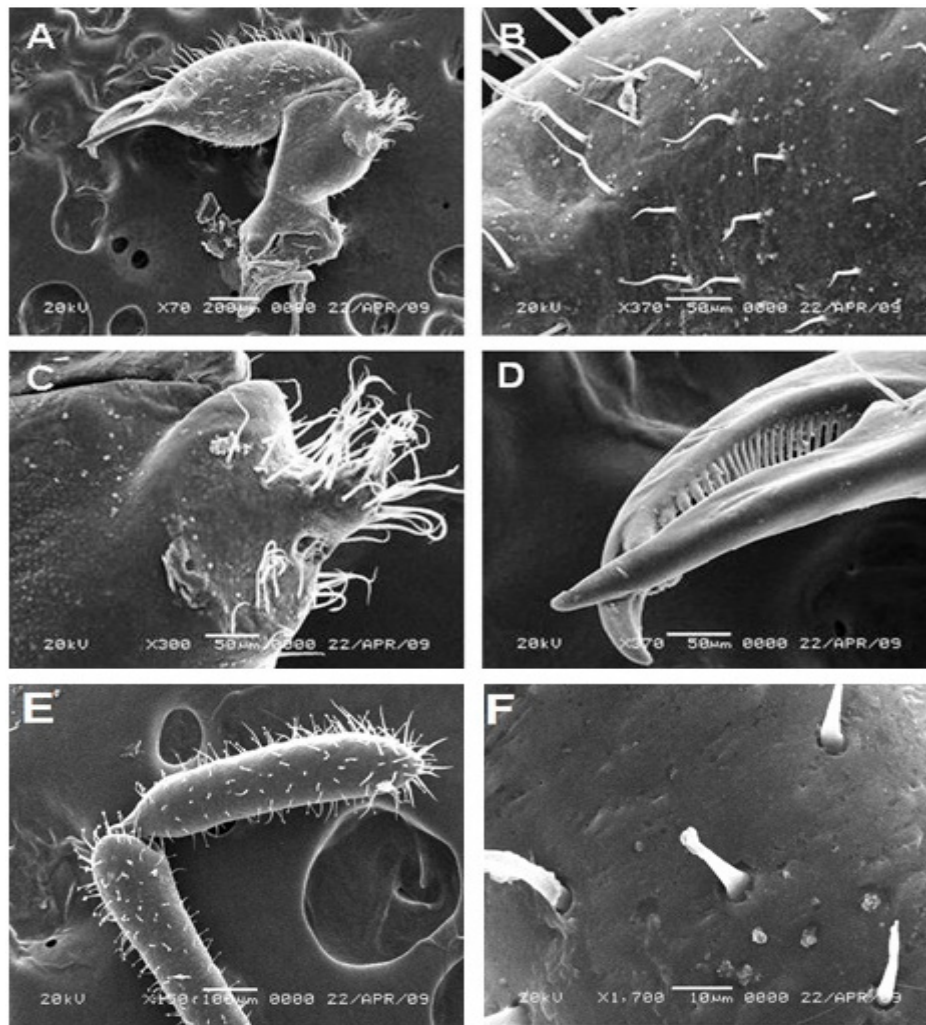


Fig. 2. *Paranemastoma karolianus*, male. A: Chelicera of the male; B: Hairs on the distal segment; C: Dorsal boss on basal segment; D: Movable and fixed fingers; E-F: Setae on tarsus of the pedipalp.

and a movable finger. The basal segment has a boss that bears many long hairs (Fig. 2A and C). No hairs on other parts of basal segment. However, the distal segment is covered by spear hairs (B). Shapes and sizes of the hairs are not regular, some of them are short and curved, and some are linear and long. The movable finger has comb-like teeth on ventral side (D). The pedipalp is long and slender. Femur is the longest segment. Tibia is two-fold shorter than femur. Distal part of the tarsus do not bear claw. All segments of the pedipalp are equipped with short and sparse hairs (E, F).

The legs are relatively long. As in all opilionids, the second leg is the longest in *P. karolianus*. The distal part of the first leg resembles a sickle. The distal segment of legs is tarsus, it articulates subdivision and has claw that bears no teeth. The

tarsus has prominent hairs, and there two types hairs on it. The one type is longer the other, the number of these hairs. These hairs are lies almost parallel to the legs. The other types of hair is short-and socket are some very significant. The hairs are approximately a 90 degree angle from the legs up. While the hairs lie flat on the segments, the setae are erect. Each seta comes from a membrane that in ring-shaped. There are two types of hair on metatarsus and tarsus. Looking to the part of the femur is less than the number of hairs. Denticles is available, typically there are a small hair between two denticle (Fig. 3).

The ventral of penis is flat, base of it is wide and is getting narrower to the apical or glans. When glans is looked at laterally small setae stand out, and they come out of the pits. These type setae are only existed on the glans, they are not

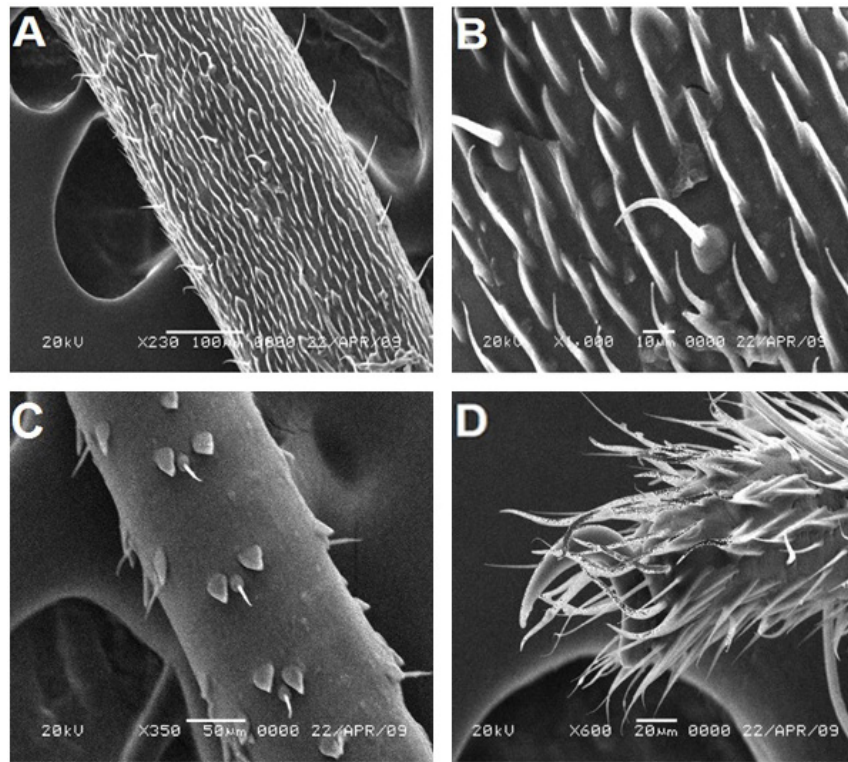


Fig. 3. *Paranemastoma karolianus*, Leg I of male. A: Tibia; B: Spines and setae on tibia; C: Denticle and spines on femur; D: Distal part of the tarsus at high magnification, dense hairs, setae and claw.

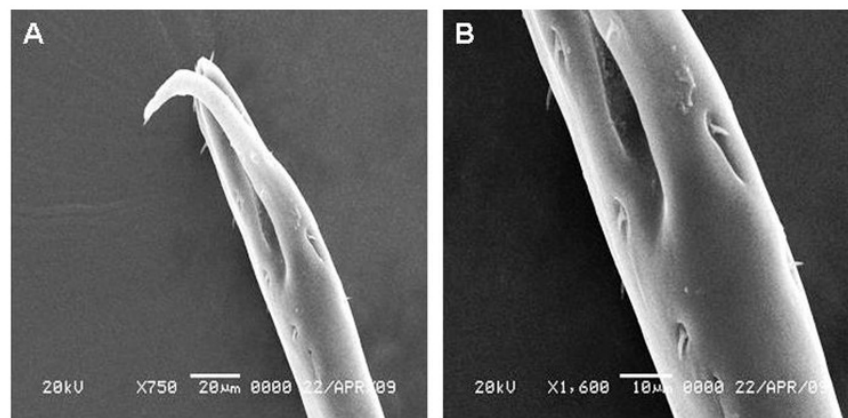


Fig. 4. *Paranemastoma karolianus*, penis glans of male. A: Latero-dorsal view; B: Setae on glans.

existed on the other parts of penis such as stylus or corpus (Fig. 4).

Habitat and distribution. *Paranemastoma karolianus* specimens were found in a location in dark zone of a forest (*Fagus* sp.) that near the entry way of Tosya. This species prefers the moist soil zone in moist habitats of decaying trees, under debris and stones.

Discussion

In Opiliones, especially male genital morphology has a key role in systematics and taxonomy. SEM and molecular genetic studies in arachnology are becoming intense to understanding the evolution of the groups, and solve taxonomic problems (Schönhofer, 2009), In this respect opilionids are felicitous materials.

In Turkish opiliofauna, in respect to morphological characters and phylogeny, the nearest species of *Paranemastoma karolianus* is *P. superbum*. Holotype of this species was recorded from Batumi by Redikorzev (1936). It is widespread in Caucasus, Turkey and Eastern Europe (Snegovaya, 1999; Mitov and Stoyanov, 2004; Martens, 2006). *P. superbum* is also type species of *Paranemastoma*. It was recorded from Zigana and Kaçkar Mountains in Turkey. Chorotype of *P. superbum* is Turano-Anatolian (Kurt et al., 2010). Also, *P. kalischevskyi* is distributed in Caucasus (Georgia and Azerbaijan) (Snegovaya and Chemeris 2005). It is recorded from Eastern Black Sea Region in Turkey (Kurt et al., 2013). Flora of this region comprises *Fagus*, *Castanea*, *Pinus*, *Ulmus*, *Fraxinus*, *Quercus* and wide steppes on alpine level.

However, *P. wegneri* was subspecies of *P. quadripunctatum* (Perty, 1833) at first. It is revised and treated as species by Schönhofer (2013). *P. quadripunctatum* is a European species, has been recorded from many places in Europe, mainly from the southern and eastern parts. *P. wegneri* was described from the Uludağ Mountain (org. Olympus Bithynicus, Turkey) first. Then it was recorded from Yugoslavia and Poland. Because of geographical reasons it was treated a subspecies of *quadripunctatum*. So, *P. wegneri* seems to be a Balkano-Anatolian.

In *Paranemastoma*, from Balkan Peninsula *P. aurigerum* (Roewer, 1951), *P. radewi* (Roewer 1926), *P. silli* (Herman 1871), *P. bureschi* (Roewer 1926) and *P. superbum* are known. Also, from Caucasus *P. kalischevskyi* (Roewer, 1951), *P. filipes* (Roewer 1919), *P. iranicum* (Martens 2006), *P. armeniacum* (Roewer 1951), *P. umbo* (Roewer, 1951) and *P. superbum* are known. *P. karolianus* was recorded from the Mid Black Sea and Eastern Black Sea Regions in Turkey. This species looks like an Anatolo-Caucasian element.

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