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RESEARCH ARTICLE

A species being worthy of its name: Intraspecific variations on the gnathosomal characters in topotypic heteromorphic males of *Cheylostigmaeus variatus* (Acari: Stigmaeidae)

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ABSTRACT: *Cheylostigmaeus variatus* (Acari: Stigmaeidae) is only known from Turkey. It has been called *variatus*, due to showing variations in the shapes of lamellae and dorsal cheliceral surfaces in the heteromorphic males. During the present work, we found five topotypic heteromorphic male specimens among mite specimens in the grassy soil and moss collected from the type locality, Ekşisu Marsh in Erzincan province, Turkey. These topotype specimens of the species including holotype and paratype were examined. During the examination, we observed variations in the shapes of lamellae, dorsal cheliceral surfaces and apophyses on the internal and external surfaces of palp femur. We consider that the differences observed in the heteromorphic male specimens are intraspecific variations, that it is true to its epithet name and that there is not enough evidences to justify a new species. This hypothesis may be supported by the rearing of a population of the species or molecular evidence.

Keywords: Gnathosoma, heteromorphic, intraspecific, mite, morphology, variation.

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INTRODUCTION

Stigmaeidae is the most widespread and abundant family in the superfamily Raphignathoidea. Most of stigmaeid species have been considered as free-living predators (Fan and Flechtmann, 2015; Fan et al., 2016). The family comprises 34 genera (Fan et al., 2016). By now, 11 genera of Stigmaeidae have been recorded from Turkey; one of them is *Cheylostigmaeus* Willmann. Members of this genus are found in all regions of the world except Antarctic (Fan and Zhang, 2005; Fan et al., 2016). By now, 34 species of the genus are known in the world (Doğan et al., 2015b; Fan et al., 2016), and 7 of which were reported from Turkey (Erman et al., 2007; Doğan, 2007, 2019; Doğan et al., 2015b; Bingül et al., 2016; Doğan and Bingül, 2017).

Distinguishing characters of the species in the genus *Cheylostigmaeus* such as the structure of the gnathosoma are mainly based on males. In this genus, the gnathosoma may show sexual dimorphism unlike other members of the family. Polymorphism may occur in males of this genus. The homeomorphic males resemble the females in the absence of lamellae on subcapitulum. The lamellae and/or the palpal apophyses are characteristic in heteromorphic males.

In the present work, morphological variations in distinguishing characters in five topotypic heteromorphic male specimens are identified in *Cheylostigmaeus variatus* Doğan, Dilkaraoğlu and Fan. Asymmetric and numerical variations in the body setae occurring in some adult females and males in some species of *Eustigmaeus*, *Stigmaeus* and *Storchia* were previously known (Akyol, 2011; Dilkaraoğlu et al., 2016a; Bingül et al., 2017a, 2017b; Bingül and Doğan, 2017; Koç and Poyraz Tınartaş, 2017). The variations in the shapes of lamellar projections, verrucae on dorsal surfaces of chelicerae and structures of apophyses on palpal segments in these specimens are noted here. With this study, we aimed to provide new data on variations observed in *C. variatus*.

MATERIAL AND METHODS

The mite specimens were extracted using Berlese-Tullgren funnels, cleared in 60% lactic acid and mounted on microscopic slides in Hoyer's medium under a Leica EZ4 stereo microscope using the standard method (Walter and Krantz, 2009). The specimens were examined and photos were taken with an Olympus BX63 microscope. Topotype specimens were coded as T1-T5.

RESULTS

In this study, we found five topotypic heteromorphic male specimens of *Cheylostigmaeus variatus* among mite specimens in the grassy soil and moss collected from the type locality, Ekşisu Marsh (Erzincan province, Turkey). These topotype specimens of the species including holotype and paratype were examined. Differential features of gnathosoma in the type specimens were noted. During the examination, we observed variations in the shapes of lamellae, dorsal cheliceral surfaces and apophyses on the internal and external surfaces of palp femur (Figs 1-6).

The lamella wing-like and lamellar projections bear four minor cusps on outer margin in holotype (Figs 1A, 4A) and are incised in paratype male (Figs 1B, 4B). The lamella is incised in one topotype (T1) as in paratype (Figs 1C, 4C). In the other topotype specimens, lamellae are not wing-like. In one topotype (T2), the left lamellar

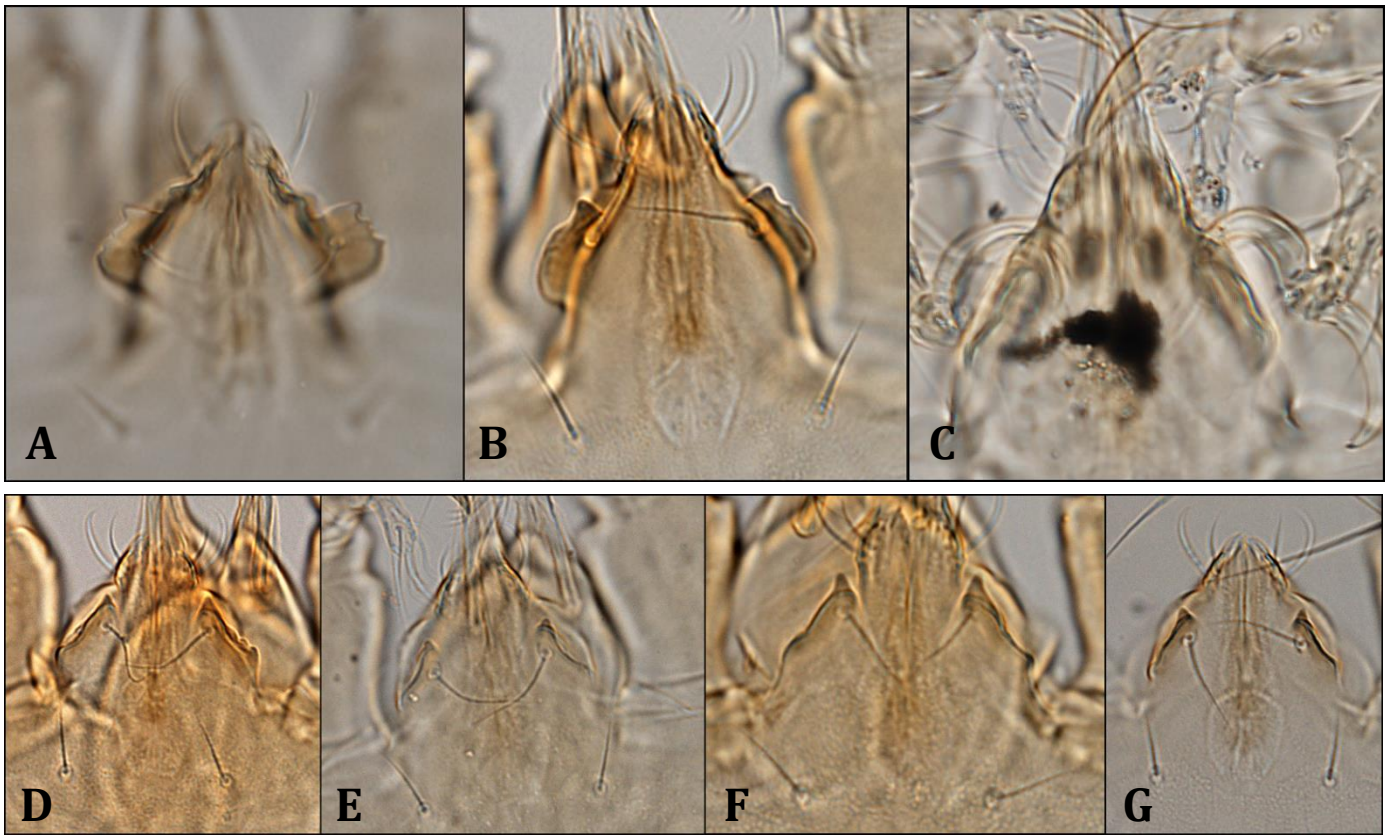

Figure 1. *Cheylostigmaeus variatus* (heteromorphic male) – Variations in the shapes of lamellar projections: A) Holotype, B) Paratype, C-G) T1-T5, respectively.

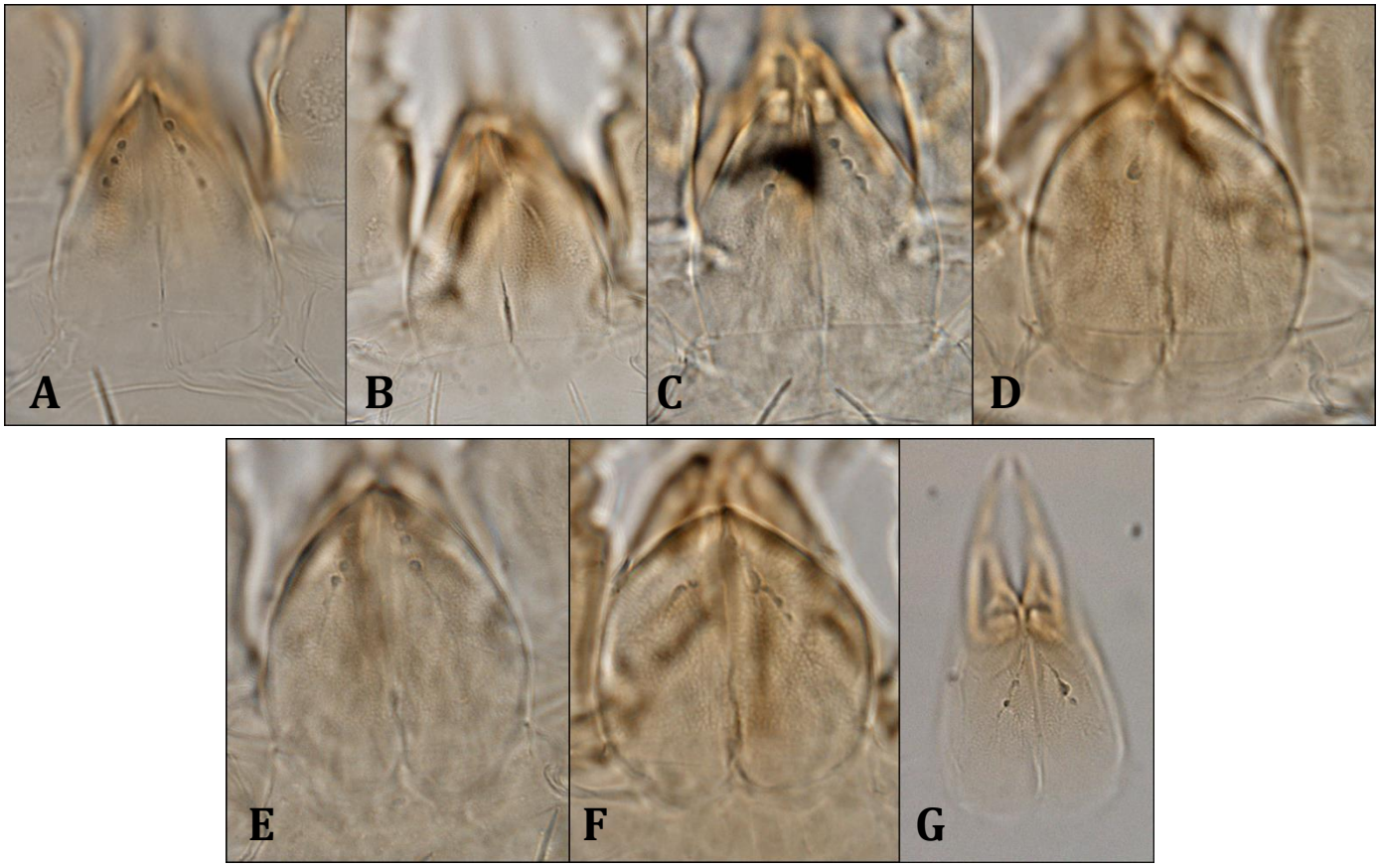

Figure 2. *Cheylostigmaeus variatus* (heteromorphic male) – Variations on dorsal cheliceral surfaces: A) Holotype, B Paratype, C-G) T1-T5, respectively.

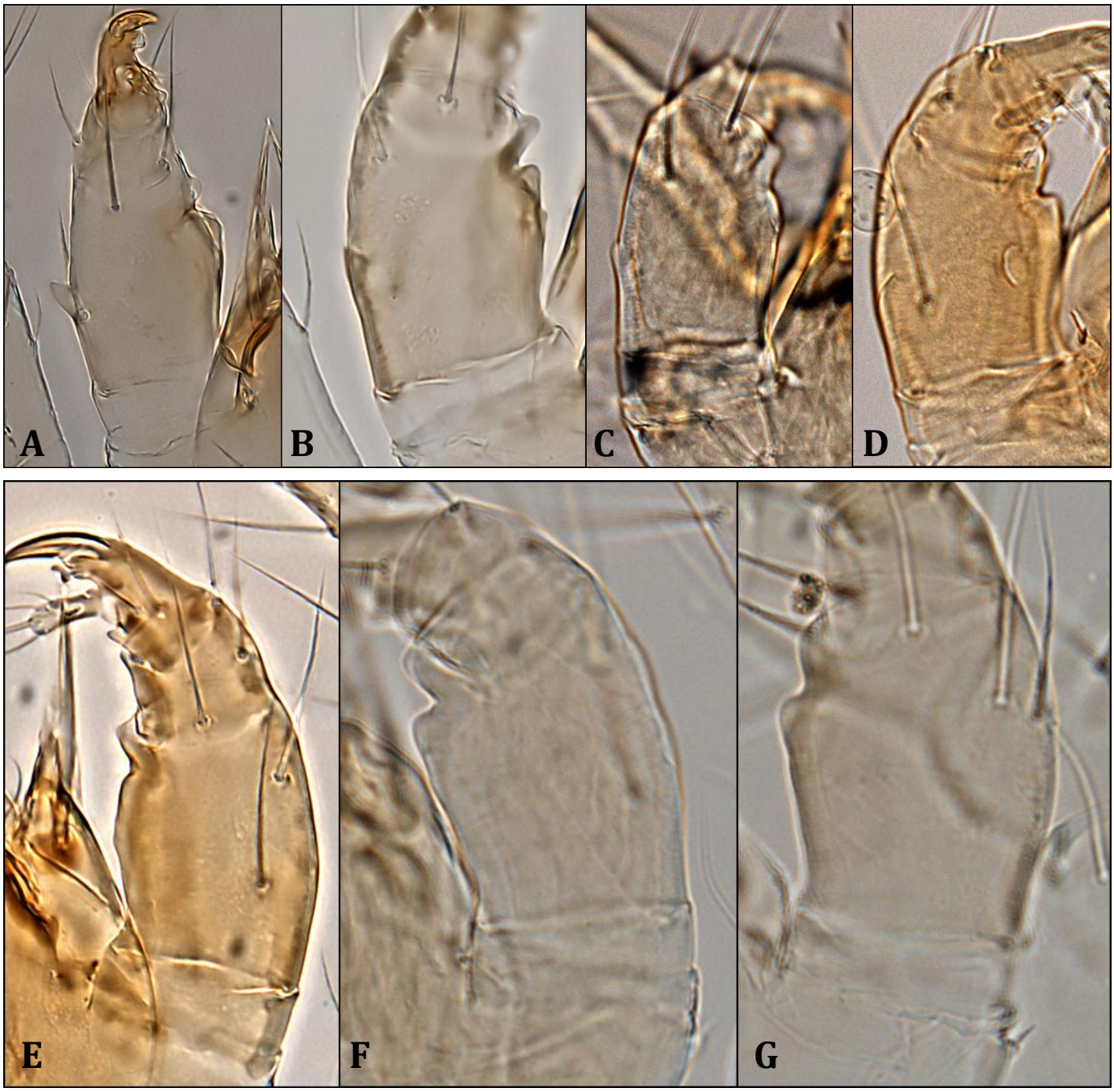

Figure 3. *Cheylostigmaeus variatus* (heteromorphic male) – Variations on the internal and external surfaces of palp femur: A) Holotype, B) Paratype, C) T1, D) T4, E-G) T2, T3 and T5, respectively.

projection with three minor cusps on outer margin while not bearing cusps on the right side (Figs 1D, 4D). Lamellae in the others (T3-T5) are similar in shape, namely pointy ear-like (Figs 1E-G, 4E-G).

Chelicerae dorsally with four pairs of verrucae in holotype (Figs 2A, 5A), sclerotic ridges in paratype (Figs 2B, 5B), and in the topotypes (T1-T5) dorsal cheliceral surfaces as shown in Figure 2 (C-G) and Figure 5 (C-G).

The external surface of femur with one spiky apophysis and its internal surface with three apophyses in holotype and paratype (Figs 3A, B, 6A, B). In two topotypes (T1, T4) apophysis in the external surface of femur are smaller than those of paratype and holotype and blunt-ended, and their internal surfaces with two apophyses (Figs 3C, D, 6C, F). In three topotypes (T2, T3, T5) apophysis in the external surface of femur is absent, and its internal surface with two apophyses (Figs 3E-G, 6D, E, G).

DISCUSSION

Cheylostigmaeus variatus has been described from Turkey by Doğan et al. (2015b), and presently only known from Turkey. The name of this species, *variatus*, refers to the variation in the shapes of lamellae and dorsal cheliceral surfaces in the males. We consider that the differences observed in the heteromorphic male specimens of the species are intraspecific variations, that this species is worthy of its name and that there is not enough evidences

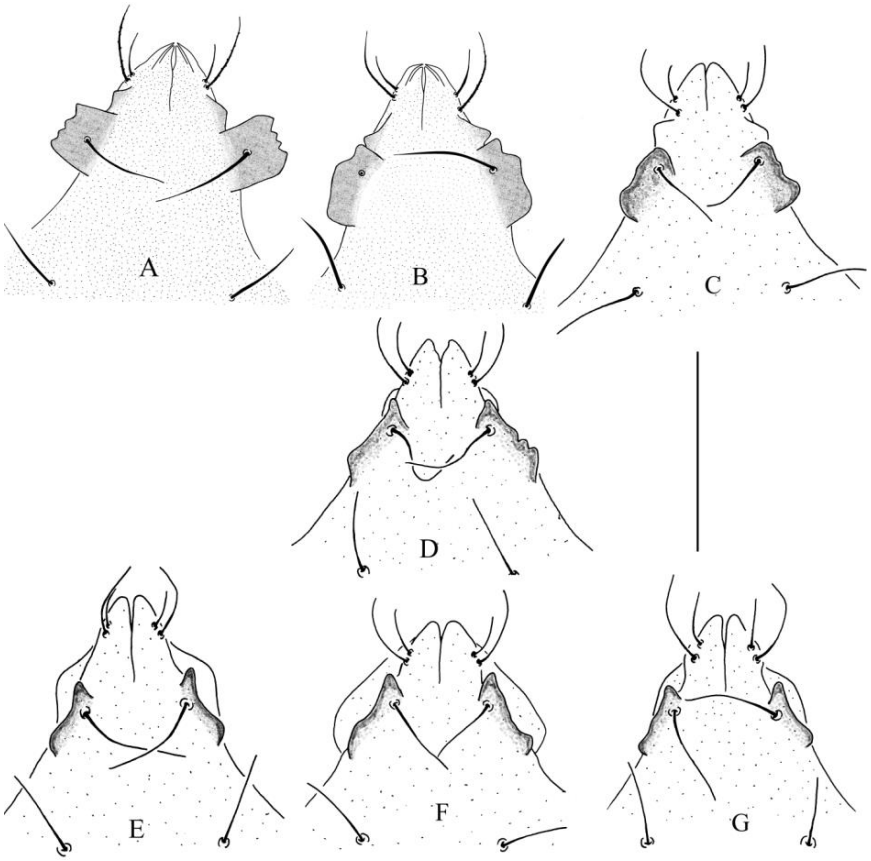

Figure 4. *Cheylostigmaeus variatus* (heteromorphic male) – Variations in the shapes of lamellar projections: A) Holotype, B) Paratype, C-G) T1-T5, respectively. Scale bar 50 µm.

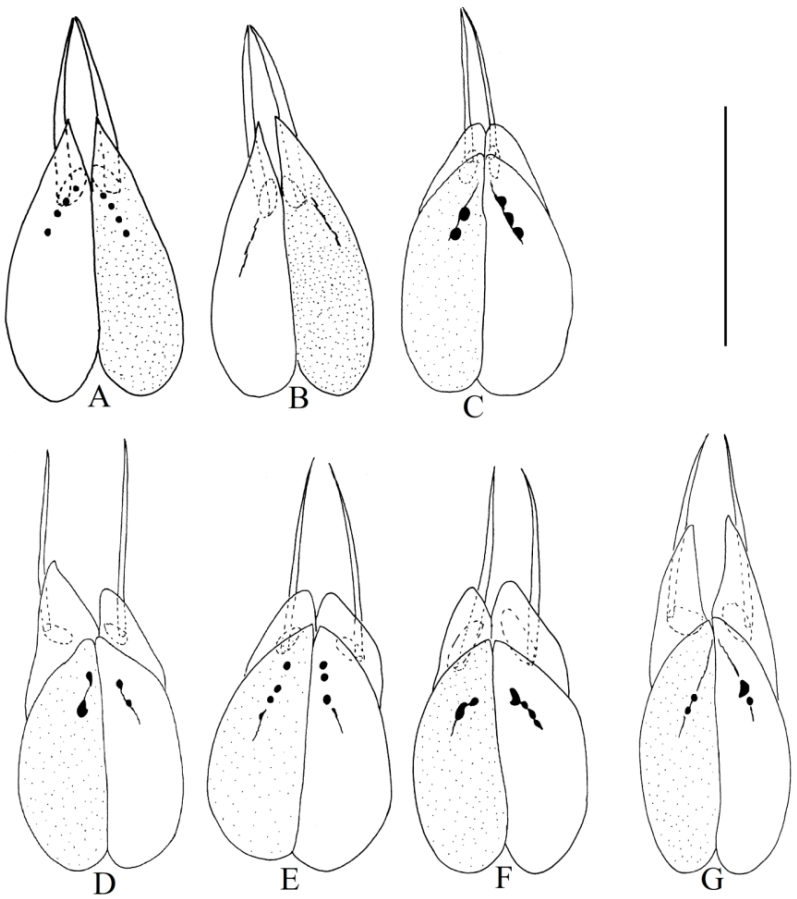

Figure 5. *Cheylostigmaeus variatus* (heteromorphic male) – Variations on dorsal cheliceral surfaces: A) Holotype, B) Paratype, C-G) T1-T5, respectively. Scale bar 100 µm.

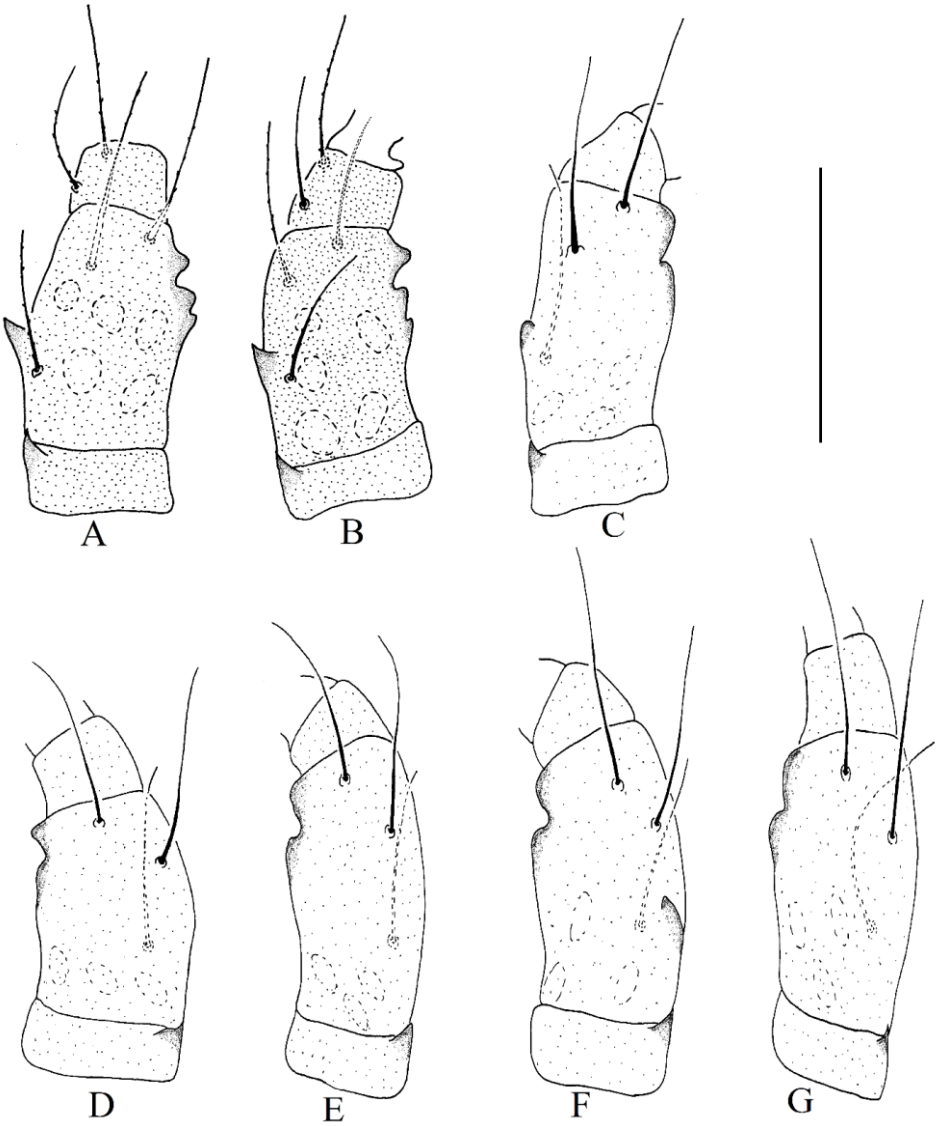

Figure 6. *Cheylostigmaeus variatus* (heteromorphic male) – Variations on the internal and external surfaces of palp femur: A) Holotype, B) Paratype, C-G) T1-T5, respectively. Scale bar 100 µm.

to justify a new species. This hypothesis cannot be further clarified until a population of *C. variatus* is reared or its molecular evidence is provided.

The mites show a variety of morphological variations, as in other organisms (Bingül et al., 2018). Intraspecific variation may be problem for species identification, and may lead to taxonomic confusion. The adaptations of organisms to different environmental conditions may cause the genetic differentiation and intraspecific variation (Bingül et al., 2017b).

In spite of many biological, faunistic and taxonomic works on stigmaeid mites, studies on their morphological variations remain limited (Akyol, 2011; Doğan et al., 2015a, 2015b, 2016, 2017; Dilkaraoğlu et al., 2016a, 2016b; Bingül and Doğan, 2017; Bingül et al., 2017a, 2017b; Koç and Poyraz Tınartaş, 2017), and external variations in the genus *Cheylostigmaeus* have not been reported yet except *C. variatus* Doğan, Dilkaraoğlu and Fan. This study will help to better explain the variations in morphological characteristics of *C. variatus*.

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