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Research Article

A Long-Legged Mite Species from Turkey: *Cheletomorpha lepidopterorum* (Shaw) (Acari: Cheyletidae)

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Abstract
Cheyletid mites (Acari: Cheyletidae) have economic importance as they are biological control agents as well as parasitic. The genus *Cheletonella* Womersley, belonging to this family, is recognized by having unusually long legs I that allows them to capture their prey. This genus currently comprises four valid species including *Cheletomorpha lepidopterorum* (Shaw). In this species palp tibial claws normally bear one large basal tooth in female, one to four teeth in male. In the Turkish specimens, this character shows unilateral and bilateral numerical variations: Each palp tibial claw bears three teeth in one male whereas one tooth in other two males, in one female right tibial claw bears two teeth while one tooth on that of left side. Palpal claws in other female are normal. *C. lepidopterorum* is one of the most striking of the cheyletids and has a cosmopolitan distribution. It has already been reported from Turkey by some authors, but none of them has given neither morphological characteristics of the species nor its description. In the this study, a re-description of this species based on two females and three male specimens collected in a straw sample from Şiran, Gümüşhane, was given. Also, other morphological variations observed in this species were discussed based on literature.

Keywords: Predatory mite, Cosmopolitan, Asymmetry, Variation, Intraspecific, Turkey

Türkiye'den Uzun Bacaklı Bir Akar Türü: *Cheletomorpha lepidopterorum* (Shaw) (Acari: Cheyletidae)

Öz
Cheyletid akarlar (Acari: Cheyletidae) biyolojik kontrol etmeni ve parazit olmaları nedeniyle ekonomik öneme sahiptirler. Bu familyaya ait olan *Cheletonella* Womersley cinsi, avlarını yakalamada görev alan, olağandışı uzunluktaki birinci çift bacakları ile tanınmaktadırlar. Bu cins günümüzde *Cheletomorpha lepidopterorum* (Shaw)'un da dâhil olduğu dört türden oluşmaktadır. Normal olarak, bu türün dişilerinde palp tibiya tırnağı büyük bir bazal diş taşımaktadır, erkeklerinde ise bu dişlerin sayısı bir ile dört arasında değişmektedir. Türkiye örneklerinde bu karakter bir taraflı ve iki taraflı sayısal varyasyonlar göstermektedir. Bir erkekte palp tibiya tırnaklarından her biri üçer diş taşırken, diğer iki erkek bireyde birer diş bulunmaktadır. Bir dişide sağ tibiya tırnağı iki diş taşırken, sol tarafta bir diş bulunmaktadır. Palp tibiya tırnakları diğer dişide ise normaldir. *C. lepidopterorum* cheyletidler içerisinde en dikkat çekici türlerden biridir ve kozmopolit bir dağılıma sahiptir. Bu türün daha önce birkaç yazar tarafından Türkiye'den kaydı verilmiş, fakat bu araştırmacıların hiçbiri bu türün ne morfolojik özelliklerini ne de tanımını vermiştir. Bu çalışmada, türün, Gümüşhane Şiran'dan toplanan saman örneklerinden elde edilen iki dişi ve üç erkek bireyi üzerinden yeniden tanımı yapılmıştır. Ayrıca bu makalede bu türle ilgili diğer morfolojik varyasyonlar literatüre dayalı olarak gözden geçirilmiştir.

Anahtar Kelimeler: Avcı akar, Kozmopolit, Asimetri, Varyasyon, İntraspesifik, Türkiye

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1. Introduction

Most of cheyletid species (Acari: Cheyletidae) are known to be predacious, but some are parasitic (Fain and Bochkov, 2001; Doğan et al., 2011; Salarzehi et al., 2018). Predator forms are natural enemies of plant feeding insects and mites. They feed mostly on eggs of small insects and on nidicolous, herbivorous, fungivorous and saprophagous mites inhabiting litter, soil, stored product, house dust and animal nest. Many free-living predaceous species are phoretic. Also, some species may cause of allergies and dermatosis in humans (Volgin, 1969; Summers and Price, 1970; Gerson et al., 1999; Fain and Bochkov, 2001; Bochkov and Fain, 2001; Doğan and Ayyıldız, 2004; Doğan et al., 2011; Akpınar et al., 2017).

The genus *Cheletomorpha* Oudemans can be characterized by: body ovoid; eyes present; dorsum with one propodosomal and one hysterosomal shield; lateral and humeral setae rod-like, barbed, medians dissimilar; palp tarsus bearing two comb-like setae and two sickle-like setae; palp tibial claw with one to four teeth; peritremes with more than 3 links; legs I longer than body, with empodia, with or without minute claws; other legs shorter, with claws and empodia (Volgin, 1969; Summers and Price, 1970; Gerson et al., 1999).

Members of *Cheletomorpha* bear long legs I. The claws and pretarsus of legs I may be absent in these mites, but the apical setae of the anterior legs are abnormally long. Probably, the legs I allow them to capture their prey (Bochkov and Fain, 2001). This genus currently comprises four valid species: *C. bakeri* Lawrence, *C. dolosus* Aheer, Akbar & Chaudhri, *C. lepidopterorum* (Shaw) and *C. tenerum* Qayyum & Chaudhri. Three species, namely *C. obrutus* Qayyum & Chaudhri, *C. opacus* Qayyum & Chaudhri and *C. orientalis* Oudemans, were considered as *species inquirendae* (Fain and Bochkov, 2001).

Cheletomorpha lepidopterorum (Shaw) were found from almost all parts of the world, and it has already been reported from Turkey (Genç and Özar 1986, Özer et al. 1986, Özkan et al. 1988, Emekçi and Toros 1999, Akpınar et al. 2017). In this study, a re-description of this species based on the specimens collected from Şiran, Gümüşhane (Turkey) has been given. Some numerical variations in terms of palp tibial claws were reported. Morphological variations in this species recorded in literature have also been discussed here.

2. Material and Methods

Berlese-Tullgren funnel was used to extraction of mites. Extracted mites stored in 70% ethanol. Specimens were cleared in 60% lactic acid and mounted on microscopic slides in Hoyer's medium under a Leica EZ4 stereo microscope using the standard method given by Walter and Krantz (2009). The mite specimens were examined and photographed by an Olympus BX63 DIC microscope. Drawings for some parts of the body were

prepared with the aid of a drawing tube attached to a Leica DM 4000B phase-contrast microscope. Measurements (micrometers μm) were taken using a Leica Application Suite (LAS) Software (3.8). Mean values are given first and the range is given parenthetically. Body length measurements represent the distance between the base of gnathosoma and posterior part of idiosoma, width was measured at the broadest point of the idiosoma. Leg length was measured from base of trochanter to tip of tarsal claws. Palp length was measured from base of trochanter to tarsal tip. Setae were measured from the setal base to tip of the seta, distances between setae was measured between the setal bases. Examined materials are deposited in Acarology Laboratory of Erzincan Binali Yıldırım University, Erzincan, Turkey. The terminology follows those of Kethley (1990) and Grandjean (1944).

3. Findings

Cheletomorpha lepidopterorum (Shaw)

Acarus lepidopterorum Shaw, 1794: 187.
Cheyletus venustissimus C.L. Koch, 1839: 23.
Cheyletus longipis Megnin, 1878: 416.
Cheyletus rufus Hardy, 1933: 352.
Cheletophyes tatami Hara, 1955: 69.
Cheletophyes knowltoni Beer & Dailey, 1956: 409.

Material examined

Two females and three males from straw, 40°05'49"N, 39°03'41"E, 1266 m, 23 April 2012, Şiran, Gümüşhane, TURKEY, coll. H.H. Özbek.

Diagnosis (Female)

Cheletomorpha lepidopterorum is a striking species with long leg I, about 1.2-1.8 times longer than idiosoma. Prodorsal shield trapezoidal, with four pairs of coarsely pubescent, flat marginal setae and two pairs of fragile, branched median setae. Humeral setae similar dorsal marginal setae. Hysterosomal shield with five pairs of coarsely pubescent, flat marginal setae and two or three pairs of fragile, branched median setae. Palp tarsus with two comb-like and two sickle-like setae. Palp tibial claw with one tooth.

Description

Female (n=2)

Body ovoid, length (including gnathosoma) (527-544), width (258-276).

Gnathosoma (Figs 1A, 6) – Length of gnathosoma (171-172), width (119-131). Rostrum conical, with two pairs of adoral setae ($or_{1,2}$). Protegmen emarginated, dorsal surface punctuated as tegmen. Peritremes with six segments on each side. Longitudinal apodeme on midventral line of subcapitulum, bifurcate between subcapitular setae. Dimension and distance between subcapitular setae, *n* (26-38), *n–n* (192-196). Palps short and thick. Palpal tarsi each with two comb-like and two sickle-like setae. Palpal claw with one tooth. Palpal tibiae each bearing one dorsal piliform seta, one lateral piliform seta and one outer ventral piliform seta. Palpal genua short and without setae.

Outwardly bulged femur striated, elbow-like in the middle of segments, with three dorsal stout setae and two ventral simple setae.

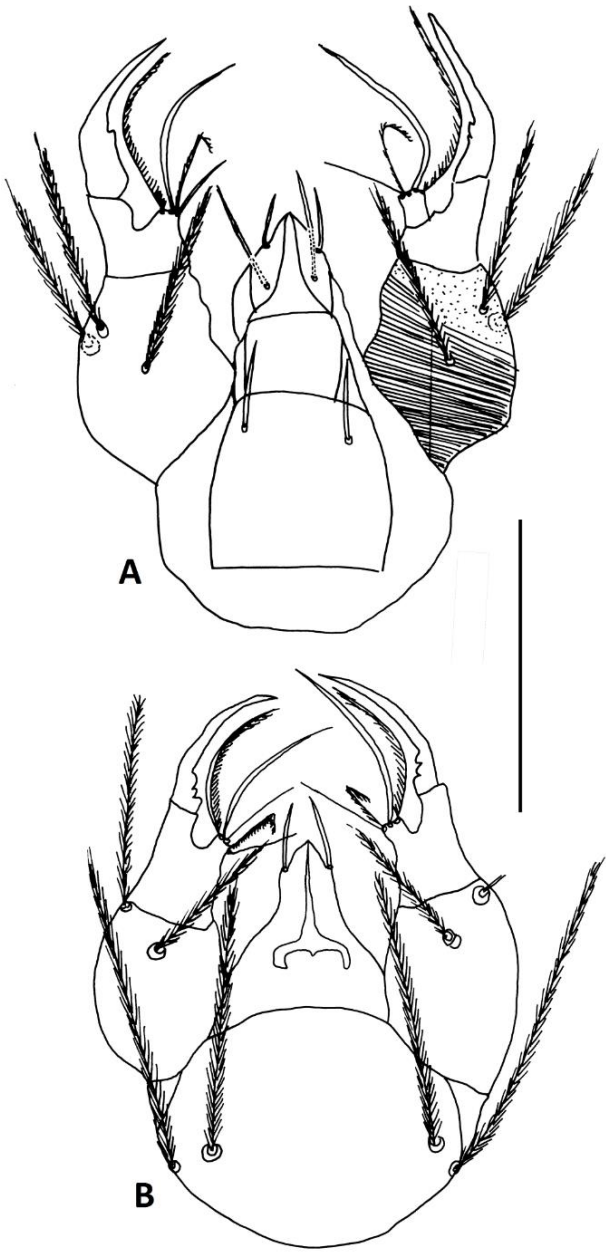

Figure 1. *Cheletomorpha lepidopterorum* (Gnathosoma) A) Female B) Male. Scale 100 µm.

Dorsum (Fig. 2A) – Covered two shields. Propodosomal shield with faint punctuations, trapezoidal, (145-180) long and (142-148) wide, bearing four pairs of coarsely pubescent, flat marginal setae and two pairs of fragile, branched median setae. One pair of humeral setae on striated integument posterolateral to propodosomal shield, humerals similar in form to the laterals. One pair of eyes on antero-lateral side. Length of hysterosomal shield (210-216), width (196-201), with faint punctuations, bearing five pairs of coarsely pubescent, flat marginal setae and three pairs of fragile, branched median setae. Hysterosomal medians and laterals in the same shape as the propodosomal medians and laterals. One pair of setae on striated integument posterior to hysterosomal shield, similar in form to marginal setae. Lengths and distances of dorsal setae as follows: *vi* (83-89), *ve* (88-91), *sci* (94-98), *sce* (92-93), c_2 (89-108), d_2 (90-102), e_2 (87-99), f_2 (82-84), h_1 (54-60), h_2 (67-73), h_3 (65-74), *vi-vi* (95-96), *ve-ve* (120-124), *vi-ve* (16-17), *sci-sci* (127-130), *ve-sci* (11-13), *sce-sce* (198-199), *sci-sce* (120-124), c_2-c_2 (256-260), d_2-d_2 (192-196), e_2-e_2 (207-211), d_2-e_2 (24-26), f_2-f_2 (165-171), h_1-h_1 (72-76), h_2-h_2 (74-78), h_1-h_2 (23-24), h_3-h_3 (146-151).

Venter (Fig. 2B) – Ventral surface striated, with simple intercoxal setae; *1a*, *3a* and *4a*. Lengths and distance of these setae: *1a* (19-21), *3a* (19-28), *4a* (21-16), *1a-1a* (18-23), *3a-3a* (26-30), *4a-4a* (52-71). Coxae in two groups, coxae I and II separated from coxae III and IV. Coxisternal shields absent. Ano-genital region with eight pairs of setae: three pairs of aggenital setae ($ag_{1,2}$), two pairs of genital setae ($g_{1,2}$) and three pairs of pseudanal setae ($ps_{1\text{-}3}$), posterior two pairs long and serrated.

Legs (Fig. 3) – Leg I (644), leg II (317-361), leg III (361-371), leg IV (406-412). Leg I about (1.2-1.8) times longer than idiosoma. Tarsus I lacking true claws but with empodium, tarsi I-III bearing them. Apical part of tarsus I with one long pectinate setae and 4 small simple setae. Chaetotaxy of leg segments as follows: coxae 2–1–2–2, trochanters 1–1–2–1, femora 2–2–2–1, genua 2(+1κ)–2–2–2, tibiae 5(+1φ)–4(+1φ)–4–4, tarsi 10(+1 ω)–7(+1 ω)–7–7. Tarsi I and II with solenidia, tarsi III and IV not bearing solenidia. Much reduced in size, solenidia φ also on tibiae I and II.

Male (n=3)

Resembles female in general appearance, but: hysterosoma somewhat tapered, hysterosomal shield with three pairs of marginal setae, all dorsomedian setae pubescent and spatulate, anogenital shields situated posteriorly, having an aedeagus, palp tibial claws with one to three teeth. Body ovoid, length (including gnathosoma) 429 (421-437), width 211 (209-213).

Gnathosoma (Figs 1B, 7) – Resembles that of female. Length of gnathosoma 148 (140-159), width 141 (139-144). Dimension and distance between subcapitular setae, *n* (16-22), *n–n* (170-180). Palp setae as in female except palpal claw with one-three teeth.

Dorsum (Fig. 4A) – Covered with two shields as in female. Propodosomal shield with faint punctuations, (150-167) long and (148-166) wide, bearing four pairs of coarsely pubescent, flat marginal setae and two pairs of pubescent and spatulate median setae. One pair of humeral setae on striated integument posterolateral to propodosomal shield, humerals similar in form to the laterals. One pair of eyes on antero-lateral side. Length of hysterosomal shield (92-102), width (102-136) with faint punctuations, bearing five pairs of coarsely pubescent, flat marginal setae and three pairs of pubescent and spatulate median setae. Anogenital region dorso-distally, with two pairs of genital and three pairs of pseudanal setae. Lengths and distances of dorsal setae as follows: *vi* 98 (81-116), *ve* 107 (84-128), *sci* 75 (66-84), *sce* 54 (53-55), cx_1 36 (25-42), c_1 29 (26-30), d_1 25(21-28), d_2 24 (21-27), e_1 29 (26-32), e_2 31 (31-32), f_1 24 (21-27), f_2 51 (47-55), h_1 22(21-22), *vi-vi* 85 (81-89), *ve-ve* 112 (109-118), *vi-ve* 18 (17-20), *sci-sci* 119 (118-121), *ve-sci* 15 (11-19), *sce-sce* 178 (174-183), *sci-sce* 109 (100-117), c_2-c_2 210 (206-215), d_2-d_2 175 (171-178), e_2-e_2 136 (131-140), d_2-e_2 20 (19-21), f_2-f_2 125 (121-130), h_1-h_1 62 (60-65).

Venter (Fig. 4B) – Ventral surface striated, with *1a*, *3a* and *4a* simple intercoxal setae. Lengths and distance of these setae: *1a* 24 (22-25), *3a* 24 (18-30), *4a* 17 (14-20), *1a-1a* 22 (18-28), *3a-3a* 24 (16-32), *4a-4a* 31 (24-36). Three pairs of aggenital setae present.

Legs (Fig. 5) – As in female. Leg I (510-610), leg II (278-346), leg III (295-334), leg IV (331-381).

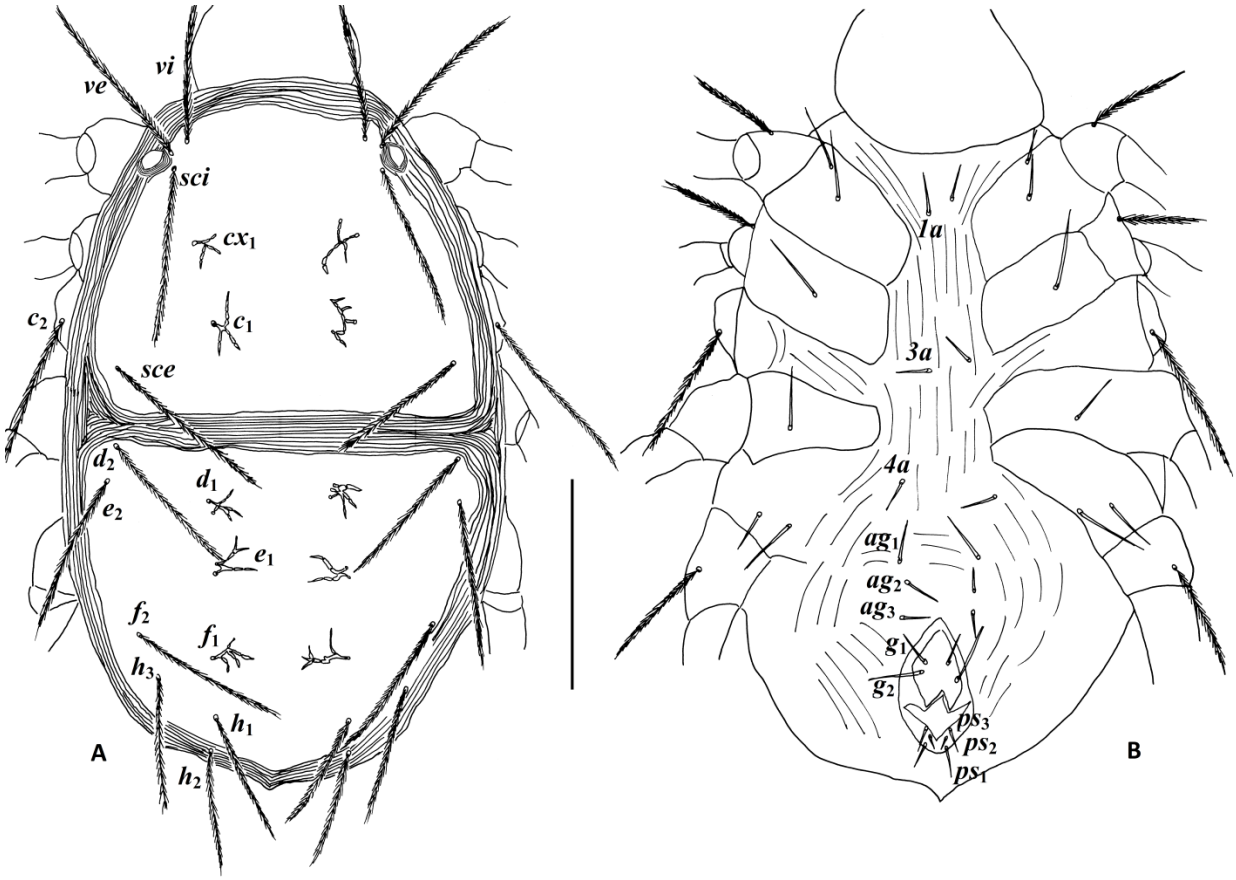

Figure 2. *Cheletomorpha lepidopterorum* (Female). A) Dorsum, B) Venter. Scale 100 µm.

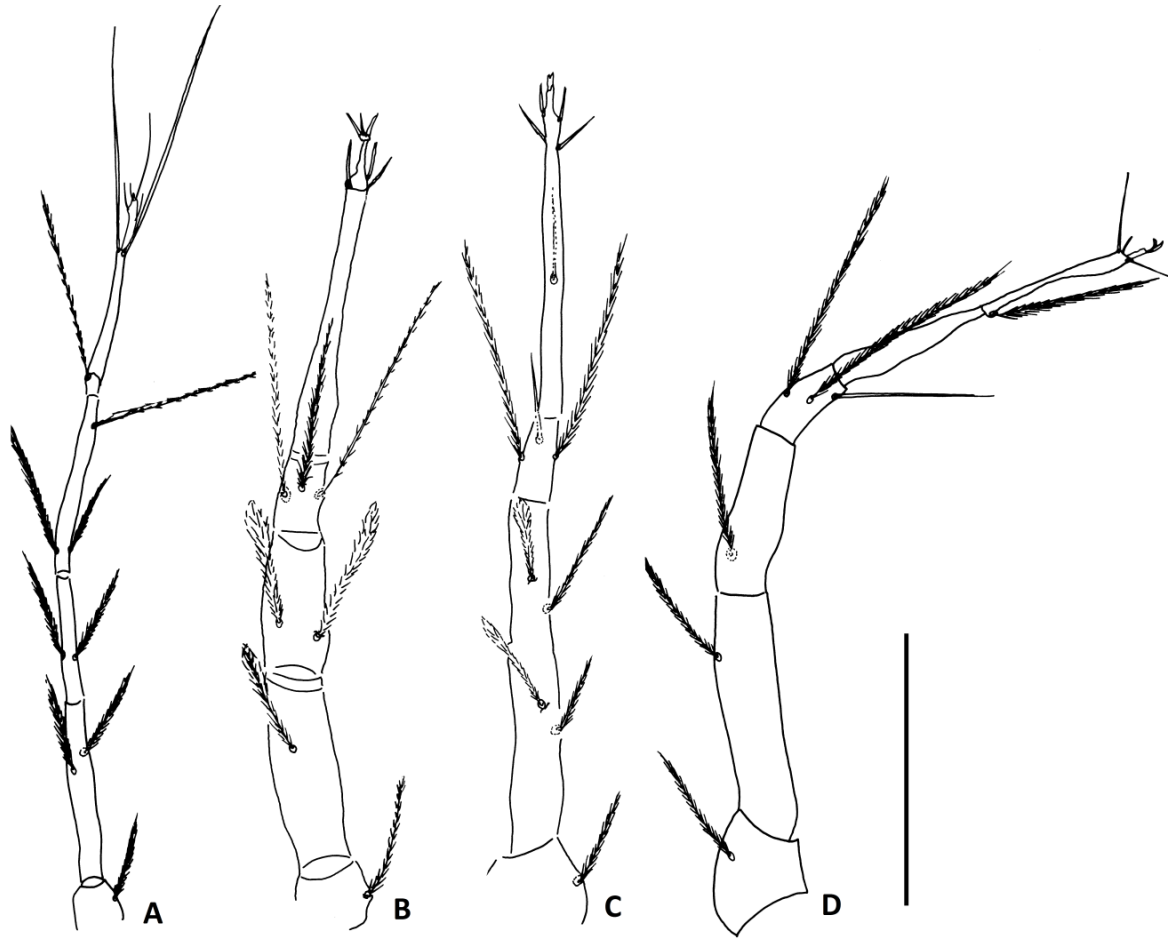

Figure 3. *Cheletomorpha lepidopterorum* (Female). A) Leg I, B) Leg II, C) Leg III, D) Leg IV. Scale 100 µm.

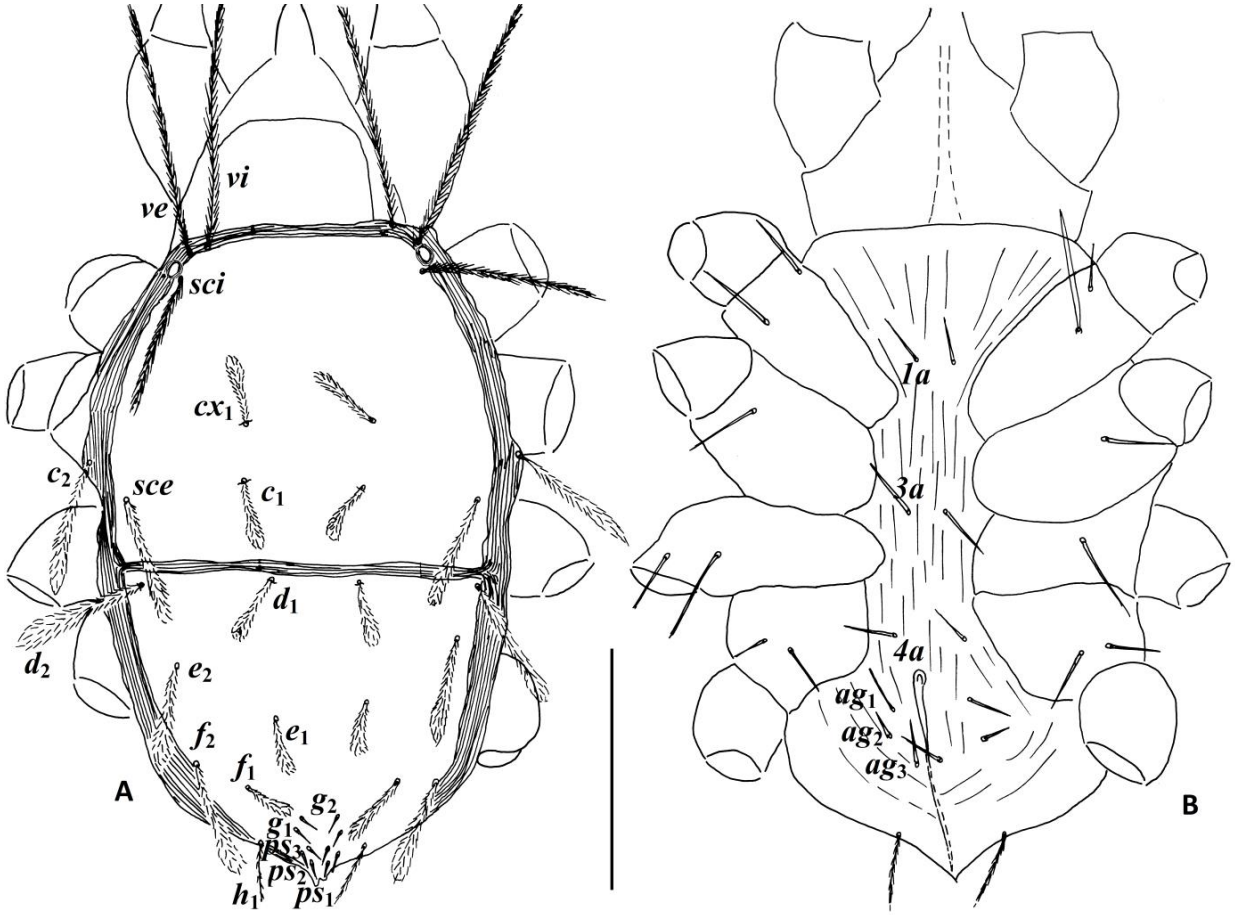

Figure 4. *Cheletomorpha lepidopterorum* (Male). A) Dorsum, B) Venter. Scale 100 µm.

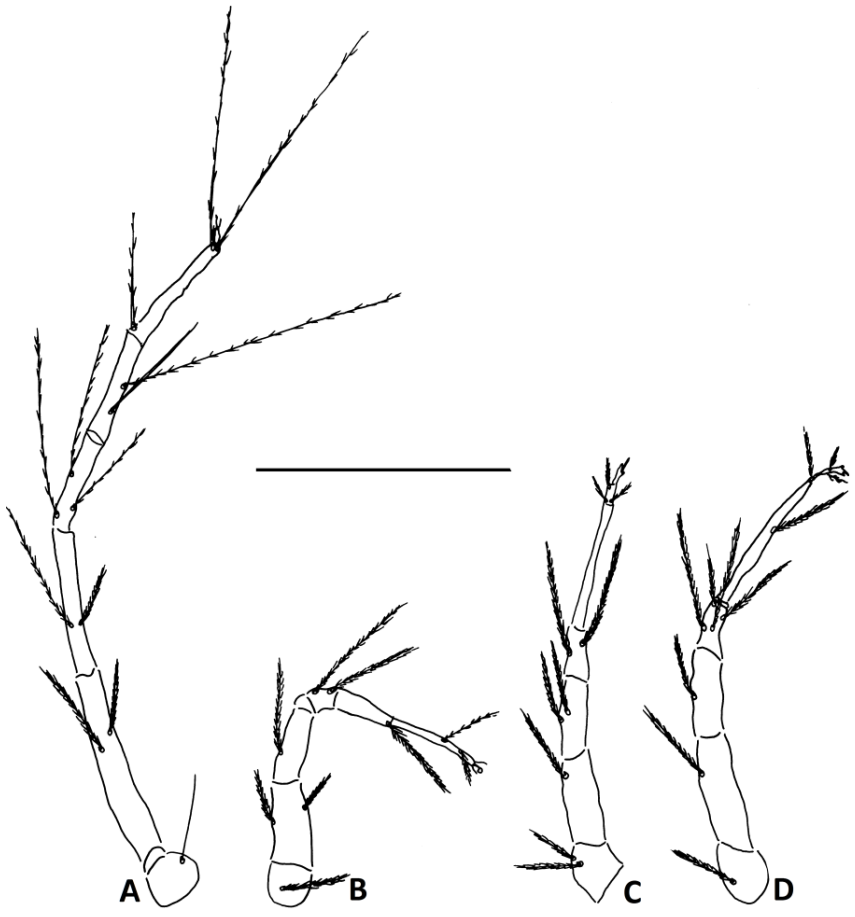

Figure 5. *Cheletomorpha lepidopterorum* (Male). A) Leg I, B) Leg II, C) Leg III, D) Leg IV. Scale 100 µm.

Figure 6. *Cheletomorpha lepidopterorum* (Female-Gnathosoma). Variation in the number of palp tibial claws.

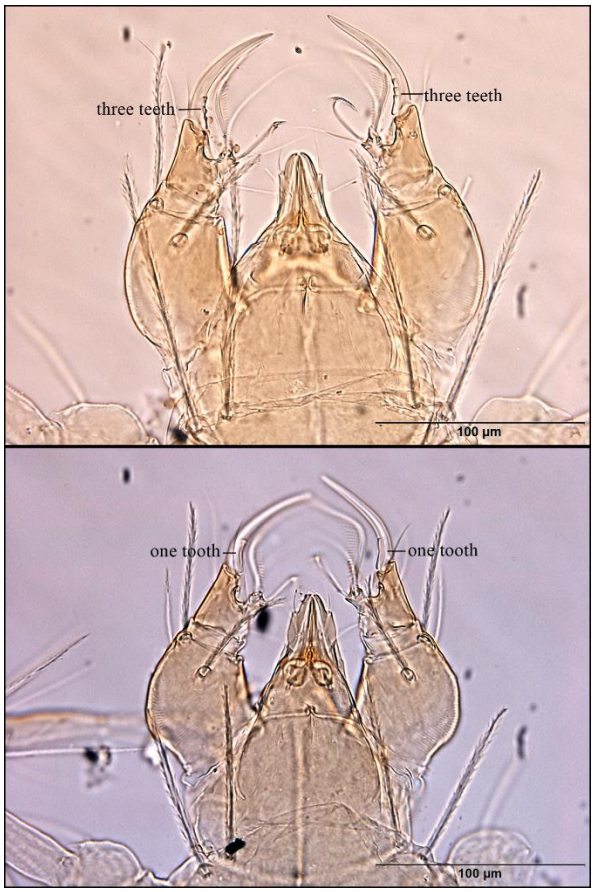

Figure 7. *Cheletomorpha lepidopterorum* (Male-Gnathosoma). Variation in the number of palp tibial claws.

Distribution

Armenia, Australia, Azerbaijan, Belgium, Brazil, Chile, China, Cuba, Egypt, England, former Czechoslovakia, France, Georgia, Germany, Greece, Hungary, India, Indonesia, Iran, Israel, Italy, Japan, Latvia, Lithuania, Malaysia, Malta, Mexico, New Guinea, New Zealand, Norway, Pakistan, Peru, Portugal, Russia, Rwanda, Spain, South Africa, *Switzerland*, Taiwan, the Netherlands, the Philippines, Transvaal, USA (Baker, 1949; Volgin, 1969; Spain and Luxton, 1971; Tseng, 1979; Žďárková, 1979; Kuznetsov and Petrov, 1984; Gerson, 1994; Peredo et al., 1994; Lucza et al., 1996; Lin and Zhang, 2000; Petrova and Salmane, 2000; Eliopoulos and Papadoulis, 2001; Fain and Bochkov, 2001; Bochkov et al., 2005; Xia, 2010; Hajizadeh et al., 2011; Silva et al., 2013; Santana, 2015; Bochkov and Abramov, 2016; Pfliegler et al., 2017; Salarzehi et al., 2018) and Turkey (Genç and Özar, 1986; Özer et al., 1986, 1989; Özkan et al., 1988; Emekçi and Toros, 1999; Akpınar et al., 2017; This study).

4. Discussion

Cheletomorpha lepidopterorum is one of the most remarkable cheyletid species that was reported in association with various hosts such as plant leaves, tree bark, soil, plant litters, food products, house dusts and bird nests. It has also been reported that phoresy of this species on butterflies is quite frequent (van Eyndhoven, 1964; Treat, 1967; Summers and Price, 1970; Bochkov and

Fain, 2001; Perotti and Braig, 2009). The specimens previously recorded from Turkey were found on stored products (Genç and Özar, 1986; Özer et al., 1986, 1989; Emekçi and Toros, 1999; Akpınar et al., 2017). Our specimens have been found in a straw sample.

In this species palp tibial claw normally bears one large basal tooth in female, one to four teeth in male. In the Turkish specimens, this character also shows unilateral and bilateral numerical variation: Each palp tibial claw bears three teeth in one male whereas one tooth in other two males (Fig. 7), in one female right tibial claw bears two teeth whereas one tooth on the left side (Fig. 6). Palpal claws in other female are normal. Numerical variations of teeth on inner margin of the palp claws may be related to the feeding habit.

Baker (1949), van Eyndhoven (1964), Volgin (1969), Summers and Price (1970), Artigas and Casanueva (1983) and Peredo et al. (1994) documented some variations in this species. Some of the specimens have small-paired claws on tarsus I, but some others do not them (Summers and Price, 1970). According to various description given by previous authors, the shape of dorsomedian setae can vary. Many of them are branched (van Eyndhoven, 1964; Volgin, 1969), but some are short simple (Baker, 1949; Artigas and Casanueva, 1983; Peredo et al., 1994). In this species, also it can be observed variation in the number of medial setae on hysterosomal shield as two or three pairs of them (Volgin, 1969). Adaptations to different environmental conditions of organisms may lead to variations in genetic and phenetic terms.

5. Acknowledgement

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