

The Caspian Sea coastal mites: redescription of *Caligonella geonoma* Smith-Meyer & Ueckermann and a new record of *Caligonella* Grandjean (Acari: Prostigmata: Caligonellidae) from Iran

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Original research

ABSTRACT

In a study on the coastal mites of the southern areas of the Caspian Sea, two caligonellid species were collected. The female of *Caligonella geonoma* Smith-Meyer & Ueckermann is re-described, and the larva of the species is described for the first time. Also, *Caligonella quinqueocellata* Khaustov is reported from Iran for the first time. Finally, an updated key to *Caligonella* species of Iran is presented.

Keywords taxonomy; soil-inhabiting mites; Trombidiformes; seashore mites

Introduction

The family Caligonellidae (Acari: Prostigmata) comprises more than 70 known species in five genera described in the following order: *Caligonella* Berlese, 1910 (12 described species); *Molothrognathus* Summers and Schlinger, 1955 (30 described species); *Coptocheles* Summers & Schlinger, 1955 (9 described species); *Neognathus* Willmann, 1952 (15 described species) and *Paraneognathus* Fan, 2000 (8 described species) distributed almost worldwide, except Australia and Antarctica (Beron 2020; Khaustov 2021 2022). Mites of the genus *Caligonella* Berlese can be readily distinguished from other caligonellids by the anterior end of peritremes situated anteroventrally (Khaustov 2021).

Until now, five species of the genus *Caligonella* have been recorded or described from Iran, namely: *C. afroensis* Smith-Meyer & Ueckermann, 1989; *C. haddadi* Bagheri & Maleki, 2013; *C. saboorii* Ahmad-Hosseini & Khanjani, 2014; *C. humilis* (Koch, 1838); *C. astragalusi* Pishehvar & Khanjani, 2020 (Pishehvar & Khanjani 2020; Bagheri & Mohammad-Doustasharraf 2020; Mohammad-Doustasharraf & Bagheri 2021). This paper deals with the caligonellid mites collected in the coastal regions of the Caspian Sea in northern Iran. The aims of this paper are: (1) redescription of the female of *C. geonoma* Smith-Meyer & Ueckermann, and description of its larva for the first time; (2) report of *C. quinqueocellata* Khaustov, 2021 from Iran; and (3) to present an updated key to the *Caligonella* species of Iran.

Material and methods

Mite specimens were extracted from the soil samples collected in southern coastal regions of the Caspian Sea (Gilan and Mazandaran provinces, northern Iran) using Berlese-Tullgren

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funnels, cleared in Nesbitt's fluid/lactophenol solution, then mounted in Hoyer's medium on microscope slides.

Morphological observations, measurements, and illustrations were made using a compound microscope equipped with differential interference contrast and phase contrast optical systems, and a drawing tube (Olympus BX53). Measurements were made in micrometers (μm). Drawings were generated in Adobe Illustrator (version 15.0.0). The abbreviations and terminology used in the description, follow that of Grandjean (1946), Norton (1977), Kethley (1990) and Swift (2001). The number of solenidia for leg chaetotaxy is given in parentheses.

Systematics

Family Caligonellidae Grandjean, 1944

Genus *Caligonella* Berlese, 1910: 203

Type species: *Stigmaeus humilis* C.L. Koch, 1838, by original designation

Caligonella geonoma Smith-Meyer & Ueckermann, 1989

Caligonella geonoma Smith-Meyer & Ueckermann, 1989, 23, figures 127–135.

Diagnosis (female)

Dorsal idiosomal shield absent, ventral idiosoma with a weakly sclerotized plate located in space between coxae I and II; solenidia on tibia I equal in length; genital setae absent, seta *vs* of tarsus I absent.

Re-description

Female (n = 6)

Figures 1–3

Length of idiosoma 385–445, width 235–295.

Dorsal idiosoma – (Figure 1A). Ovate. Dorsal idiosoma completely striated, without dorsal shield. Two pairs of ocelli located posterolaterad setae *sci*, posterior ocellus poorly visible. Cupuli *ia*, *im* and *ip* large, almost round; *ia* located just posteriad ocelli, *im* anterolaterad seta *d* and *ip* laterad seta *f*. All dorsal idiosomal setae almost subequal, short, smooth and pointed. Anal valves located dorsoterminal, weakly striated; one pair of pseudanal setae. Lengths of dorsal setae: *vi* 15–17, *ve* 15–16, *sci* 13–15, *sce* 15–17, *cl* 14–16, *c2* 15–16, *d* 15–17, *e* 15–17, *f* 15–16, *h1* 16–19, *h2* 15–18, *ps1* 7–11.

Ventral idiosoma – (Figure 1B). Ventral idiosoma striated, except a smooth oval area located in space between coxae I and II. Coxal fields I-II and III-IV with sparsely distributed puncta. All ventral setae smooth and pointed. Three pairs of aggenital setae; genital setae absent; cupuli *ih* located posterolaterad *ag2*. Lengths of ventral setae: *1a* 33–36, *1b* 21–24, *1c* 23–35, *2c* 19–22, *3a* 30–32, *3b* 17–20, *4a* 27–30, *4c* 20–23, *ag1* 25–27, *ag2* 13–16, *ag3* 11–14.

Gnathosoma – (Figure 2). Stylophore almost oval (Fig. 2 A), distinctly punctate and finely striated, its length 65–70, width 50–62; peritremes distinctly curved in central part of stylophore. Palpal supracoxal setae *ep* 3–4 small, thick, located in deep depression with terminal pore. Palpal chaetotaxy: Tr 0, Fe 1 (*d*), Ge 1 (*d*), Ti 3 (*d*, *l'*, *l''*), Ta 7(1) (*ba*, *bp*, *va*, *acm* ζ , *ul'* ζ , *ul''* ζ , *sul* ζ , ω); tibial claw well developed, slightly hooked; all palpal setae smooth, eupathidia *acm* ζ , *ul'* ζ , *ul''* ζ , *sul* ζ blunt-tipped, other palpal setae pointed. Subcapitulum with few sparsely distributed puncta and finely striated (Figure 2B); seta *or2* thick and with rounded tip, other subcapitular setae smooth and pointed, lengths of subcapitular setae: *m* 28–32, *or1* 5–7, *or2* 8–9, length of palptarsal solenidion ω 3.

Legs – (Figure 3). Lengths of legs (excluding claws): I 277–289, II 238–253, III 242–257, IV 252–275. Leg I (Figure 3A) longer than other legs. Leg setation: Tr 1 (*v'*), Fe 2 (*d*, *bv''*), Ge

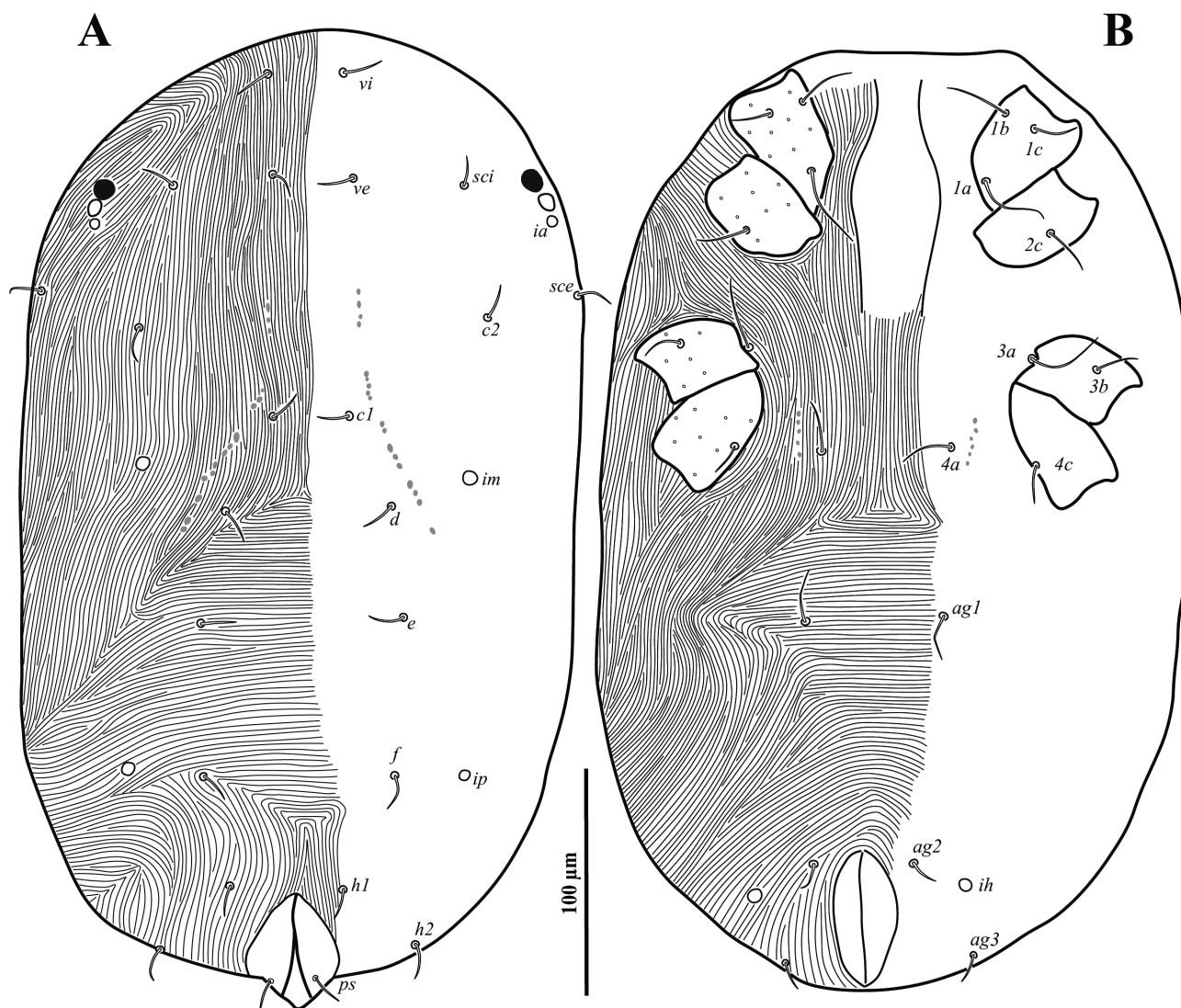


Figure 1 *Caligonella geonoma* Smith-Meyer & Ueckermann (female). A – dorsal idiosoma; B – ventral idiosoma.

6 ($d, l', l'', v', v'', \kappa$), Ti 5(2) ($d, l', l'', v', v'', \phi, \phi p$), Ta 15(1) ($ft', ft'', pv', pv'', pl', pl'', tc'\zeta, tc''\zeta, p'\zeta, p''\zeta, it', u', u'', a', a'', \omega$). All setae smooth and pointed, Setae κ of genu, and (p), (tc), of tarsus eupathid-like. Solenidion ω 8–9 digitiform; solenidion ϕ and ϕp almost equal in length 4–5 baculiform. Leg II (Figure 3B). Leg setation: Tr 1 (v'), Fe 2 (d, bv''), Ge 5 (d, l', l'', v', v''), Ti 5 (d, l', l'', v', v''), Ta 11(1) ($ft', pv', pv'', tc', tc'', p'\zeta, it', u', u'', a', a'', \omega$). All setae smooth and pointed, seta p'' of tarsus eupathid-like. Solenidion ω 8–9 digitiform. Leg III (Figure 3C). Leg setation: Tr 1 (v'), Fe 2 (d, ev'), Ge 1 (d, v'), Ti 4 (d, l'', v', v''), Ta 9 ($tc', tc'', pv', pv'', it', u', u'', a', a''$). All setae smooth and pointed. Leg IV (Figure 3D). Leg setation: Tr 1 (v'), Fe 2 (d, ev'), Ge 1 (d, v'), Ti 4 (d, l'', v', v''), Ta 9 ($tc', tc'', pv', pv'', it', u', u'', a', a''$). All setae smooth and pointed.

Larva (n = 2)

Figures 4–6

Length of idiosoma 204, 234, width 128, 167.

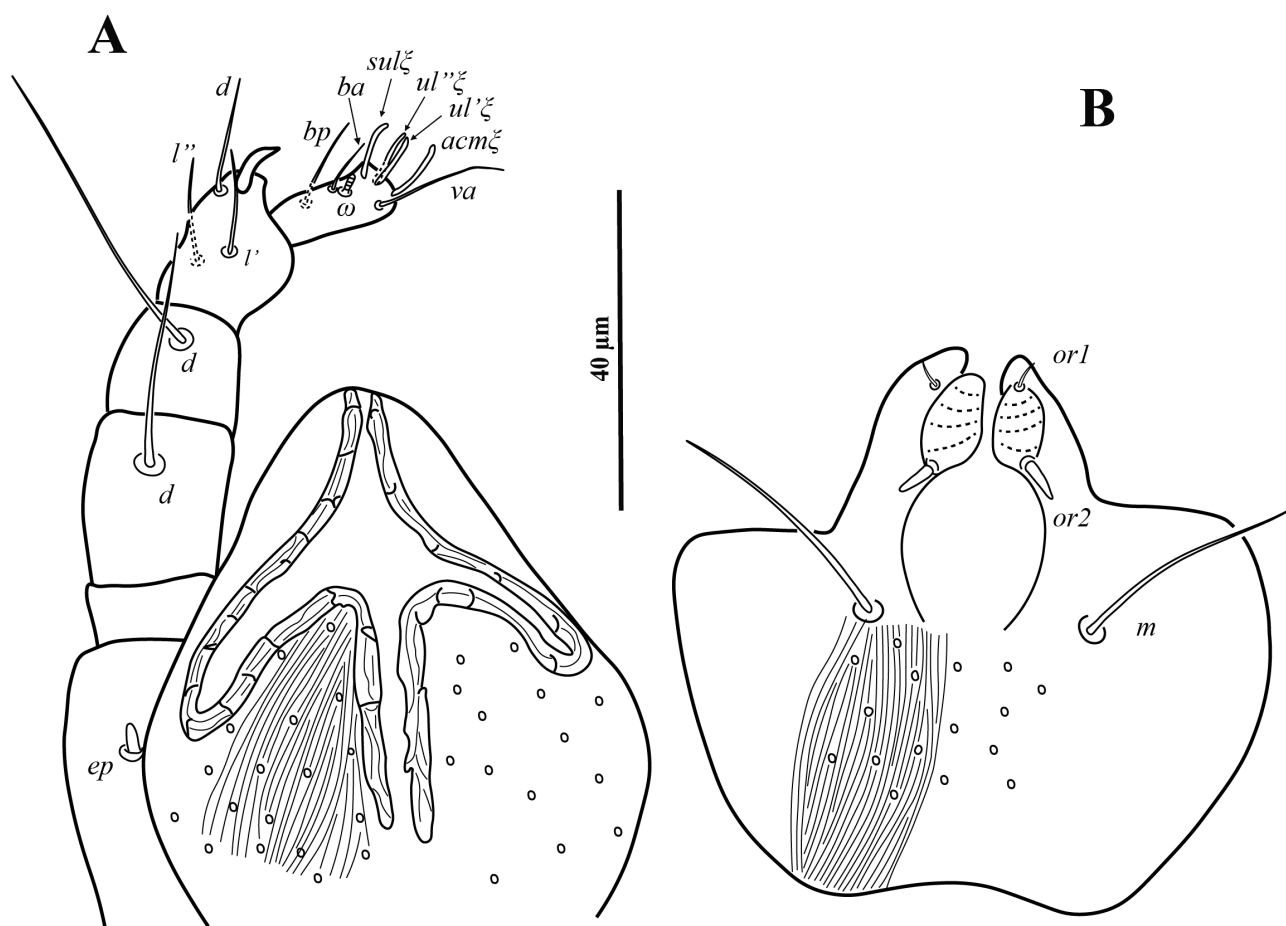


Figure 2 *Caligonella geonoma* Smith-Meyer & Ueckermann (female). A – dorsal view of gnathosoma; B – subcapitulum.

Dorsal idiosoma – (Figure 4A). Completely striated, without dorsal shield. Dorsal setae and cupuli as in female. Anal opening terminal. Lengths of dorsal setae: *vi* 13, 15, *ve* 14, 15, *sci* 16, 17, *sce* 20, 23, *cl* 12, 13, *c2* 14, 15, *d* 13, 16, *e* 15, 16, *f* 16, 16, *h1* 20, 22, *h2* 28, 33.

Ventral idiosoma – (Figure 4B). Ventral idiosoma completely striated except with a smooth oval area located in space between coxae I. Coxal field I with two setae (*1a*, *1b*), coxal field II without setae, coxal field III with one setae (*3a*); genital and aggenital setae absent. Seta *ps* located on ventral part. All ventral setae smooth and pointed; cupuli *ih* located anteromesad *h2*. Lengths of ventral setae: *1a* 29, 33, *1b* 23, 25, *3a* 28, 29, *ps* 8, 10.

Gnathosoma – (Figure 5). In general, similar to that of female except following: peritremes straight, subcapitulum without setae *m*, seta *or2* thick and with rounded tip (Figure 5B). Palpal supracoxal setae (*ep*) 3 small, thick, located in deep depression with terminal pore; palptarsus with setae *acm* and *sul* simple (not eupathidia) (Figure 5A). Length of stylophore 39, 44, width 40, 45, lengths of setae: *or1* 5, 5, *or2* 6, 7, length of palptarsal solenidion (*ω*) 3.

Legs – (Figure 6). Lengths of legs: I (197, 204), II (154, 174), III (181, 189). Leg I (Figure 6 A) longer than other legs. Leg setation: Tr 0, Fe 2 (*d*, *bv''*), Ge 5 (*l'*, *l''*, *v'*, *v''*, *κ*), Ti 5(2) (*d*, *l'*, *l''*, *v'*, *v''*, *φ*, *φp*), Ta 14(1) (*ft'*, *ft''*, *pv'*, *pv''*, *pl'*, *pl''*, *tc'*, *tc''*, *p'*, *p''*, *u'*, *u''*, *a'*, *a''*, *ω*). All setae smooth and pointed, setae *p''* and *tc''* of tarsus eupathid-like. Setae *κ* 3, Solenidion *ω* 5–6 digitiform; solenidion *φ* and *φp* almost equal in length 3–4 baculiform. Leg II (Figure 6 B). Leg setation: Tr 0, Fe 2 (*d*, *bv''*), Ge 4 (*l'*, *l''*, *v'*, *v''*), Ti 5 (*d*, *l'*, *l''*, *v'*, *v''*), Ta 10(1) (*ft'*, *pv'*,

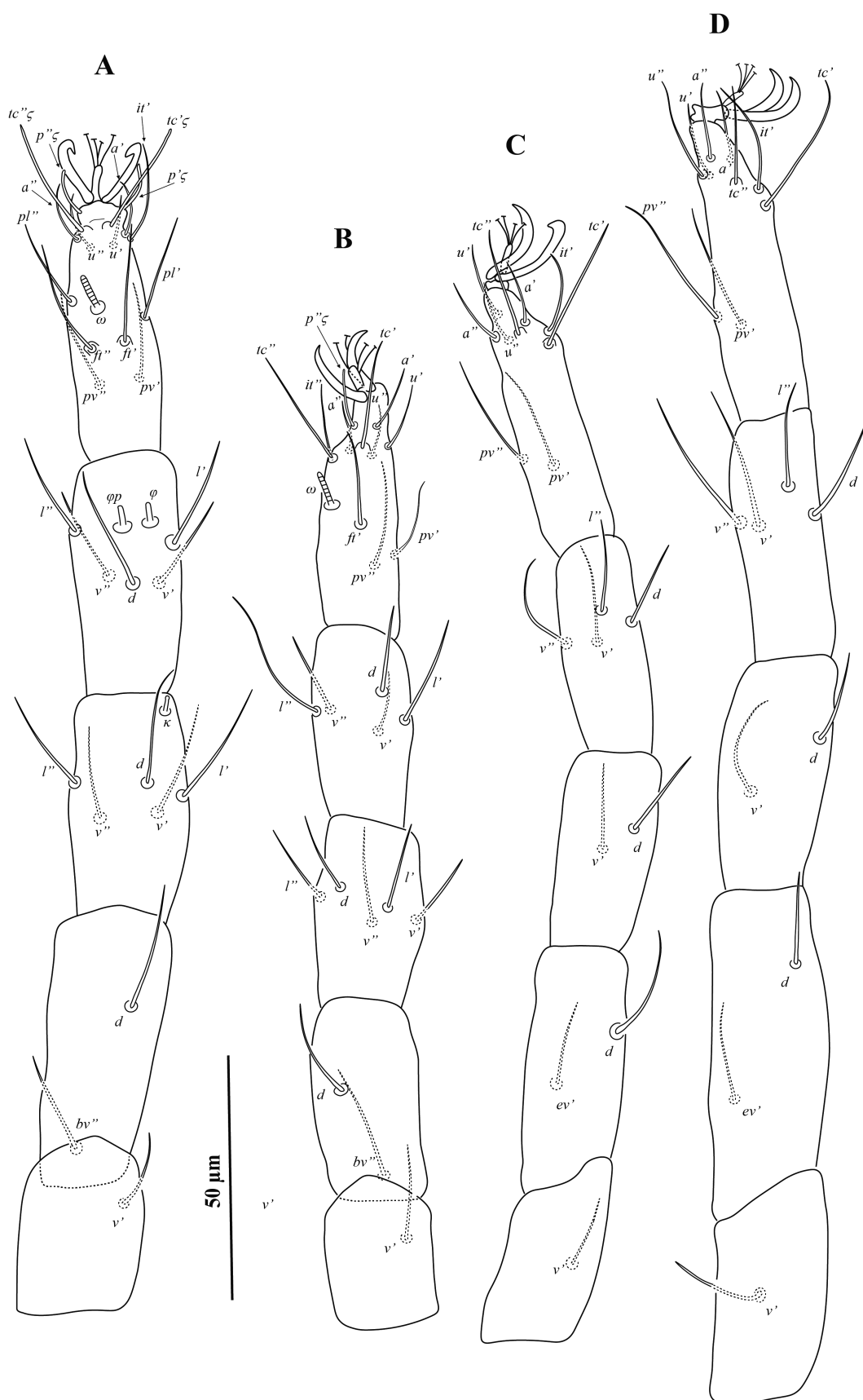


Figure 3 *Caligonella geonoma* Smith-Meyer & Ueckermann (female). A – dorsal view of left Leg I; B – dorsal view of left leg II; C – dorsal view of left leg III; D – dorsal view of left leg IV.

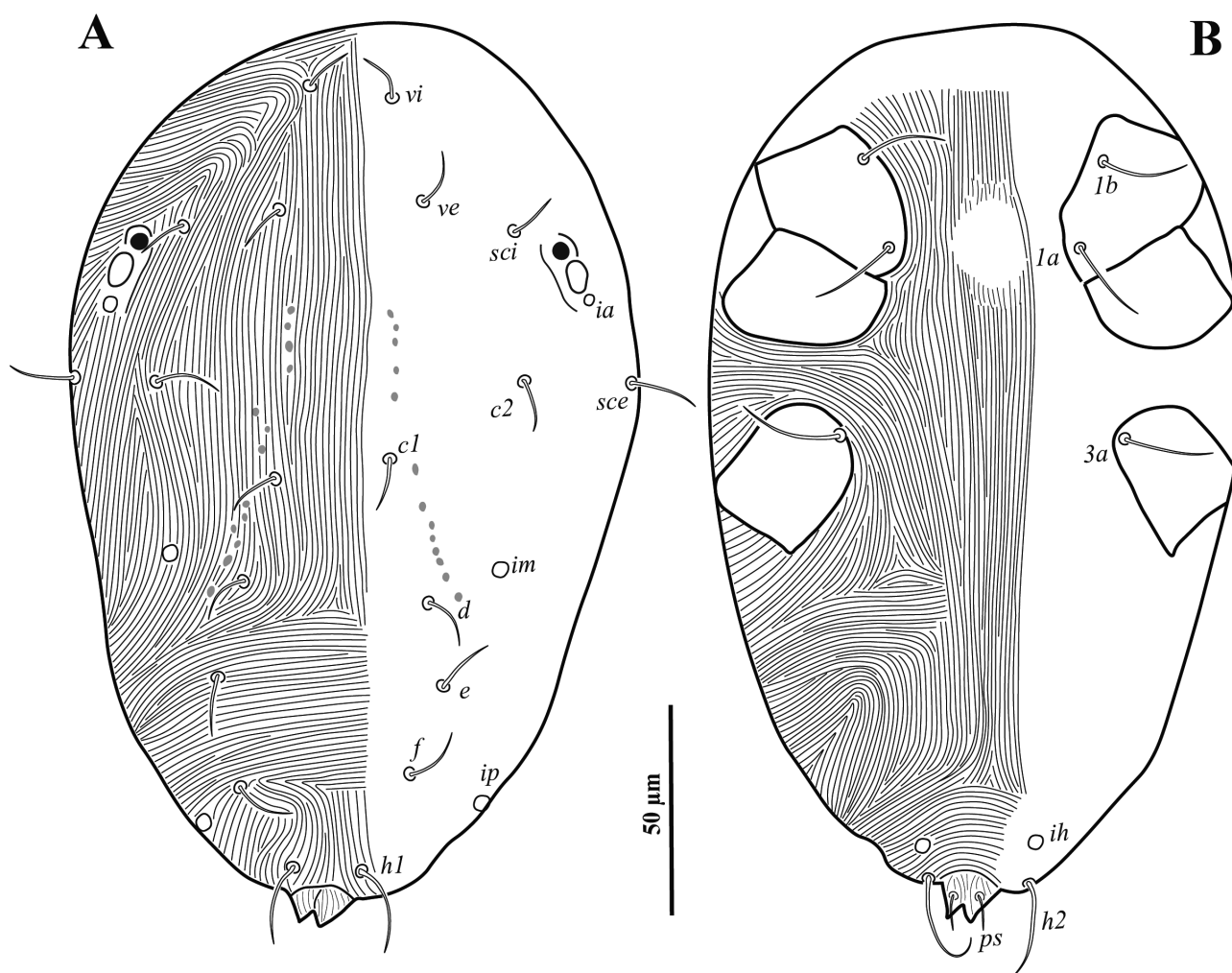


Figure 4 *Caligonella geonoma* Smith-Meyer & Ueckermann (larva). A – dorsal idiosoma; B – ventral idiosoma.

pv'', *tc'*, *tc''*, *p''* ζ , *u'*, *u''*, *a'*, *a''*, ω). All setae smooth and pointed, seta *p''* of tarsus eupathid-like; Solenidion ω 5–6 digitiform. Leg III (Figure 6C). Leg setation: Tr 0, Fe 3 (*d*, *ev'*), Ge 1 (*v'*), Ti 4 (*d*, *l''*, *v'*, *v''*), Ta 8 (*pv'*, *pv''*, *tc'*, *tc''*, *u'*, *u''*, *a'*, *a''*). All setae smooth and pointed.

Male, and other immature stages unknown.

Material examined – Four females from sandy soil on seashore, Rezvan-Shahr County (37° 34' 20" N, 49° 11' 52" E), -29 m a.s.l., Gilan Province, 23 April 2021, col. M.M. Khanzadeh, will be deposited in the Acarological collection of the Acarology Laboratory, Plant Protection Department, Faculty of Agriculture, University of Maragheh, Iran (UMI); two females with same collection data, will be deposited in the Acarology Collection of the Jalal Afshar Zoological Museum, Department of Plant Protection, Faculty of Agriculture, Tehran University, Karaj, Iran (JAZM). One larva from sandy soil on seashore, Bandar-e Anzali County (37° 28' 05" N, 49° 32' 24" E), -29 m a.s.l., Gilan Province, 23 April 2021, col. M.M. Khanzadeh, will be deposited in UMI. One larva from sandy soil and cockleshell in coastal region of Miankale Peninsula (36° 50' 13" N, 53° 25' 14" E), -32 m a.s.l., Mazandaran Province, 09 November 2021, col. F. Pazhum, will be deposited in JAZM.

Remarks – *Caligonella geonoma* Smith-Meyer & Ueckermann was originally described from Dendron, Transvaal, South Africa (Smith-Meyer & Ueckermann 1989) based on female, male and protonymphs. This species resembles *Caligonella afroensis* Smith-Meyer & Ueck-

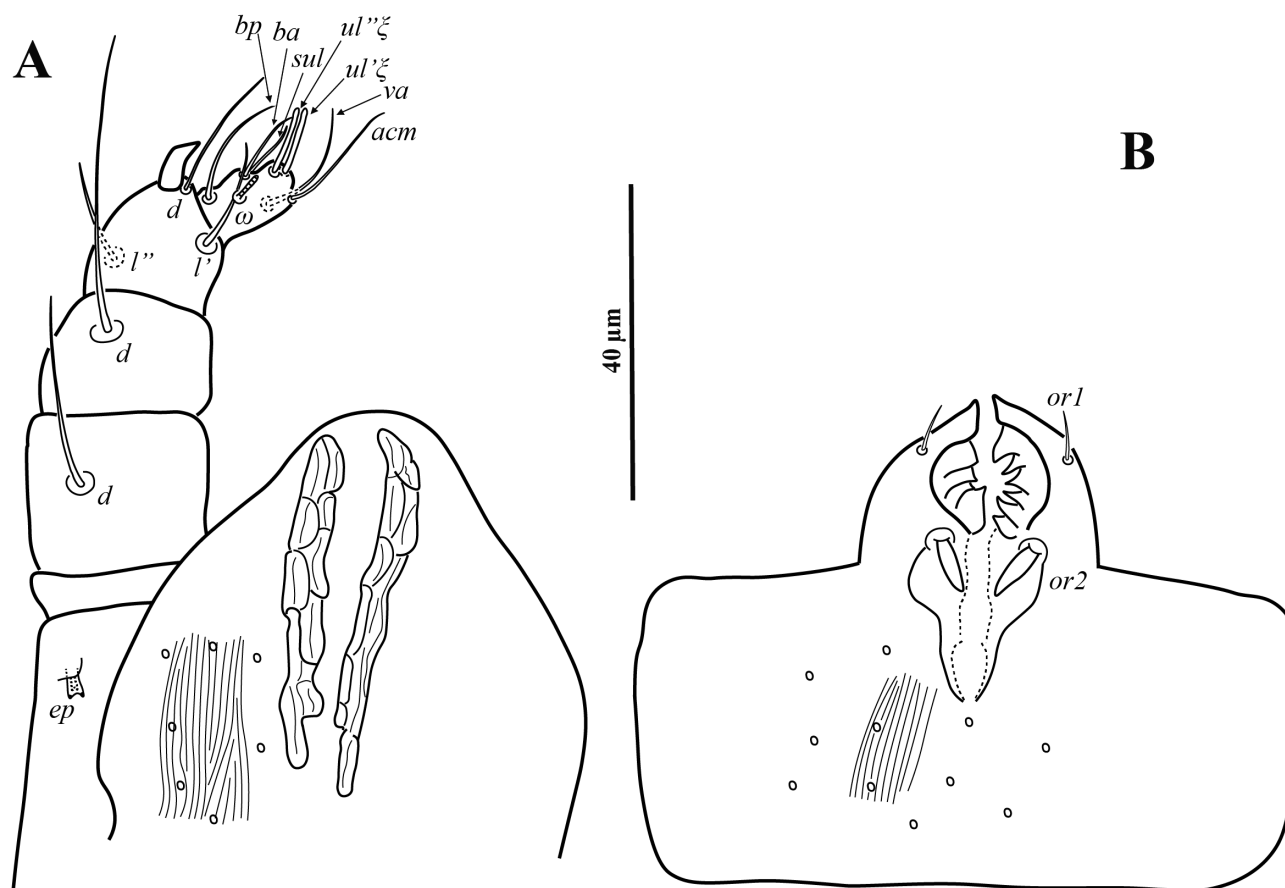


Figure 5 *Caligonella geonoma* Smith-Meyer & Ueckermann (larva). A – dorsal view of gnathosoma; B – subcapitulum.

ermann in having the same ventral idiosoma plate between coxae and leg chaetotaxy but it differs from that by the outer solenidion on tibia I longer than inner solenidion in female of *C. afroensis* versus equal in length in *C. geonoma*. Iranian collected specimens exhibit most features of the original descriptions but in the original description, the authors not mentioned details of lengths of body setae, legs and palp setal information of which so important in these group of mites and modern taxonomy. However, here we re-described females and described of its larva for the first time.

***Caligonella quinqueocellata* Khaustov, 2021**

Caligonella quinqueocellata Khaustov, 2021: 911, figures 1–8.

This species was recently described from moss on sandy soil in Crimea (Khaustov 2021). This is the first record of *C. quinqueocellata* from Iran. Specimens from Iran agree well with the original description, especially in having unusual five pairs of ocelli on prodorsum, presence of dorsal idiosomal shield, and in having one pair of pseudanal setae.

Material examined – One female from sandy soil and cockleshell in coastal region of Miankale Peninsula (36° 50' 13" N, 53° 26' 19" E), -29 m a.s.l., Mazandaran Province, 09 November 2021, col. F. Pazhum, will be deposited in UMI.

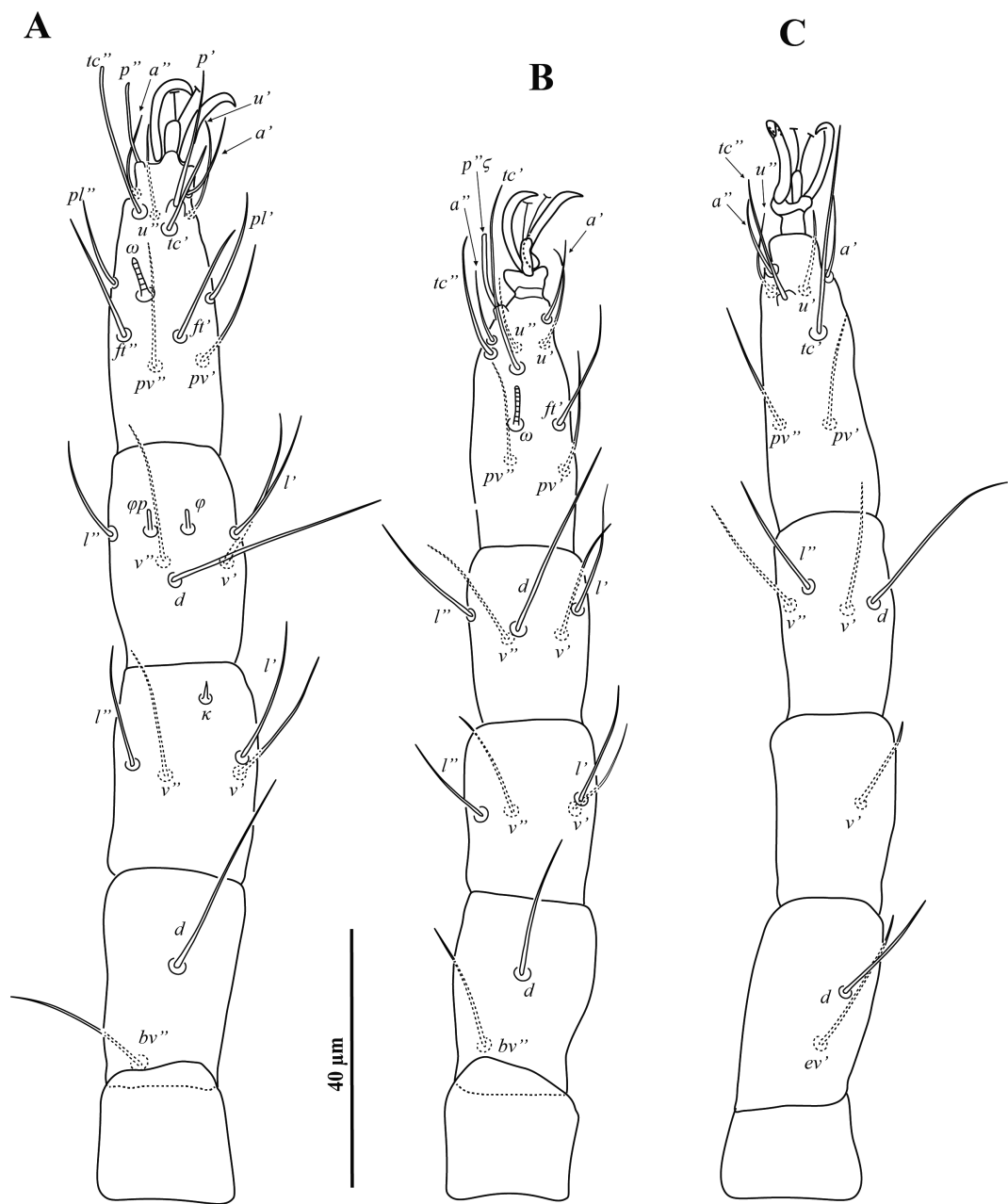


Figure 6 *Caligonella geonoma* Smith-Meyer & Ueckermann (larva). A – dorsal view of left leg I; B – dorsal view of left leg II; C – dorsal view of left leg III.

Key to *Caligonella* of Iran (females)

- 1. Dorsal idiosomal shield present; five pairs of ocelli on prodorsum *C. quinqueocellata* Khaustov, 2021
- Dorsal idiosomal shield absent; two pairs of ocelli on prodorsum 2
- 2. Ventral idiosoma with a plate between coxae 3
- Ventral idiosoma without plate between coxae 4

3. Solenidia on tibia I equal in length *C. geonoma* Meyer & Ueckermann, 1989
 — Outer solenidion on tibia I almost two times longer than inner solenidion
 *C. afroensis* Smith-Meyer & Ueckermann, 1989
4. Outer solenidion on tibia I three times as long as inner solenidion
 *C. haddadi* Bagheri & Maleki, 2013
 — Outer solenidion on tibia I two times as long as inner solenidion 5
5. Solenidia on tarsi I and II equal in length *C. saboorii* Ahmadhoseini & Khanjani, 2014
 — Solenidion on tarsus I about two times longer than solenidion on tarsus II 6
6. Tarsi I–II with 15+1 ω –11+1 ω setae respectively, lateral loops of peritremes almost extending to lateral margin of stylophore *C. astragalusi* Pishehvar & Khanjani, 2020
 — Tarsi I–II with 14+1 ω –10+1 ω setae respectively, lateral loops of peritremes not extending to lateral margin of stylophore *C. humilis* (Koch, 1838)

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