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Two new species of Caligonellidae (Acari: Raphignathoidea) from Crimea

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Original research

ABSTRACT

Female and larva of *Caligonella quinqueocellata* n. sp. and female, larva and protonymph of *Molothrognathus tauricus* n. sp. (Caligonellidae) are described from moss on the sandy soil from northern part of Crimea.

**Keywords** Prostigmata; mites; *Caligonella*; *Molothrognathus*; systematics; morphology

**Zoobank** http://zoobank.org/8BC6D62A-C7B0-4AEF-AB2C-854B4A7CF3C1

Introduction

The family Caligonellidae is a small group of predatory prostigmatid mites, which comprises 5 genera and about 60 species distributed almost worldwide, except Australia and Antarctica (Beron 2020). The caligonellid mites of Crimea are poorly studied. Previously only one species, *Molothrognathus dilucidus* Kuznetsov was described from Crimea (Kuznetsov 1978).


During the study of soil predatory mites, two new species, *Caligonella quinqueocellata n. sp.* and *Molothrognathus tauricus n. sp.* were collected from moss on the sandy soil in northern part of Crimea. Both species were collected from the same sample. The aim of this paper is to describe and illustrate these new species.

**Material and methods**

Mites were collected from the soil samples by Berlese funnels. Collected mites were mounted in Hoyer’s medium. Notation applied to the body and leg setae follow that of Grandjean’s system, overviewed by Kethley (1990) and Norton (1977) applied to Caligonellidae by Swift (2001); palpal setation follows Grandjean (1946). Mite morphology was studied using an AxioImager A2 compound microscope (Carl Zeiss, Germany) with phase-contrast and differential interference contrast (DIC) illumination. Photomicrographs were taken with an AxioCam ICC5 digital camera. All measurements are given in micrometers (μm) for holotype and available paratypes (in parentheses). For leg chaetotaxy, the number of solenidia is given in parentheses.

**Results**

**Systematics**

**Family Caligonellidae Grandjean, 1944**

**Genus Caligonella Berlese, 1910**

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

**Caligonella quinqueocellata n. sp.**

Zoobank: 3FE8CEF5-57DF-4523-BF9A-9F15AE42AA02 (Figures 1–8)

**Diagnosis** — **Female**. Dorsal shield present, seta ve located on soft cuticle; prodorsum with five pairs of ocelli; one pair of pseudanal setae; ventral plate absent.

**Description**

**Female** (Figs 1-5) — Length of idiosoma 460 (405), width 275 (255).

Idiosomal dorsum (Figs 1A, 3A, 5B, C) – Ovate. Dorsal idiosomal stria thick, usually double; dorsal shield well developed, ovate, with few sparsely distributed puncta and fine stria (Fig. 5C) and located in space between setae vi, ve, and c1, its length 135 (130), width 68 (58). Five pairs of ocelli located posterolaterad setae sci, anterior ocellus much bigger than four posterior (Figs 3A, 5B). Cupuli ia, im and ip very large, almost round; ia located just posteriad ocelli, im posteriolateral c1 and ip laterad f. All dorsal idiosomal setae subequal, short, smooth and indistinctly blunt-tipped. Anal valves located dorso terminal, weakly striated and with few sparsely distributed puncta; one pair of pseudanal setae. Lengths of dorsal setae: vi 17 (17), ve 17 (17), sci 20 (19), sce 21 (18), c1 16 (15), c2 18 (15), d 18 (15), e 17 (14), f 15 (13), h1 15 (12), h2 16, ps 15 (12).

Idiosomal venter (Figs 1B, 5D) – Ventral idiosoma without plate between coxae, striated. Coxal fields I-II and III-IV with sparsely distributed puncta; coxal field IV with posterior plate-like projection delineated by stria and sparsely distributed puncta. All ventral setae smooth and pointed. Three pairs of aggenital and one pair of genital setae (Fig. 5D); cupuli ih located anteriolaterad ag3. Lengths of ventral setae: la 27 (26), lb 28 (26), lc 17 (17), 2c 15 (13), 3a 25 (26), 3b 17 (13), 4a 20 (19), 4c 20 (16), ag1 18 (18), ag2 16 (12), ag3 14 (12), g 12 (11).

Gnathosoma (Figs 2, 3B, C, 5A) – Stylophore almost oval (Fig. 2 A), distinctly punctate in anterior 2/3 and finely striated in posterior 1/3 parts, its length 110 (100), width 91 (75);
peritremes distinctly curved in central part of stylophore (Figs 2A, 3B, 5A); cheliceral levers large, oval, almost as long as cheliceral stylets (Fig. 5C). Palpal supracoxal setae (ep) 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, hp, va, acmζ, ul' ζ, ul'' ζ, sulζ, ω); tibial claw well developed, slightly hooked; all palpal setae smooth, eupathidia acmζ, ul' ζ, ul'' ζ, sulζ with slightly swollen tips, other palpal setae pointed. Subcapitulum with few sparsely distributed puncta (Fig. 2B); all subcapitular setae smooth, setae m pointed, adoral setae weakly blunt-tipped; lengths of subcapitular setae: m 33, or1 66, or2 88, length of palptarsal solenidion ω 43.

Legs (Fig. 4) – Lengths of legs (excluding claws): I 300 (280), II 230 (210), III 250 (220), IV 295 (250). Leg I (Fig. 4A) longer than other legs. Leg setation: Tr 1 (v'), Fe 2 (d, bv''), Ge 6 (d, l', l'', v', v'', k), Ti 5(2) (d, l', l'', v', v'', φ, φp), Ta 16(1) (ff', ff'', tc' ζ, tc'' ζ, p' ζ, p'' ζ, it', a').

a″, u′, u″, vs, pv′, pv″, pl′, pl″, ω). Supracoxal seta of leg I (el) located in deep depression with terminal pore; seta k of genu located in deep depression; all leg setae smooth; setae (tc) and (p) eupathid-like, blunt-tipped, other leg setae pointed; solenidion ω 8 (7) digitiform, solenidia φ 4 (4) and ep 12 (12) baculiform. Leg II (Fig. 4B). Leg setation: Tr 1 (vl′), Fe 2 (d, bv″), Ge 5 (d, l′, l″, v′, v″), Ti 5 (d, l′, l″, v′, v″), Ta 11(1) (fl′, tc′, tc″, p″, it′″, a″, u′, u″, pv′, pv″, ω). All leg setae smooth; seta p″ eupathid-like, blunt-tipped; other leg setae pointed; solenidion ω 7 (7) digitiform. Leg III (Fig. 4C). Leg setation: Tr 1 (vl′), Fe 2 (d, ev′), Ge 2 (d, v′), Ti 4 (d, l′, v′, v″), Ta 9 (tc′, tc″, it′″, a″, u′, u″, pv′, pv″). All leg setae smooth and pointed. Leg IV (Fig. 4D). Leg setation: Tr 1 (vl′), Fe 2 (d, ev′), Ge 2 (d, v′), Ti 4 (d, l′, v′, v″), Ta 9 (tc′, tc″, it′, a″, u′, u″, pv′, pv″). All leg setae smooth and pointed.

Larva (Figs 6-8) — Length of idiosoma 245, width 170.

Idiosomal dorsum (Fig. 6A) – completely striated, without dorsal shield. Dorsal setae and cupuli as in female. With one pair of large anterior ocelli, posterior ocelli indistinct. Anal opening terminal. Lengths of dorsal setae: vi 11, ve 10, sci 11, sce 12, ci 10, c2 10, d 9, e 10, f 11, h1 13, h2 11, ps 7.

Idiosomal venter (Fig. 6B) – Ventral idiosoma completely striated. Coxal field I with two setae (la, lb), coxal field III with one setae (3a); genital and aggenital setae absent. All ventral setae smooth and pointed; cupuli ih located anteromesad h2. Lengths of ventral setae: la 19, lb 15, 3a 16.
Figure 3 Caligonella quinqueocellata n. sp., female: A – anterolateral part of prodorsum, B – anterior part of stylophore, dorsal aspect. C – anterior part of stylophore, ventral aspect.

Gnathosoma (Fig. 7) – in general similar to that of female except following: peritremes straight, subcapitulum without setae m, palptarsus with setae acm and sul simple (not eupathidia). Length of stylophore 56, width 53, lengths of setae: or1 6, or2 7, length of palptarsal solenidion ω 3.

Legs (Fig. 8) – Lengths of legs: I 170, II 130, III 145. Leg I (Fig. 8A) longer than other legs. Leg setation: Tr 0, Fe 2 (d, bv’), Ge 5 (l’, l”, v’, v”, k), Ti 5(2) (d, l’, l”, v’, v”, φ, φp), Ta 15(1) (ff’, ft”, tc’, tc”, p’ζ, p”ζ, a’, a”, u’, u”, vs, pv’, pv”, pl”, pl”). Seta k of genu located in shallow depression; all leg setae smooth; setae (p) eupathid-like, blunt-tipped, other leg setae pointed; solenidion ω 7 digitiform, solenidia φ 3 and φp 7 baculiform. Leg II (Fig. 8B). Leg setation: Tr 0, Fe 2 (d, bv”), Ge 4 (l’, l”, v’, v”), Ti 5 (d, l’, l”, v’, v”), Ta 10(1) (ff’, tc’, tc”; p’ζ, a’, a”, u”, u”, pv’, pv”, ω). All leg setae smooth; seta p”ζ eupathid-like, blunt-tipped; other leg setae pointed; solenidion ω 6 digitiform. Leg III (Fig. 8C). Leg setation: Tr 0, Fe 2 (d, ev’), Ge 1 (v’), Ti 4 (d, l”, v’, v”). Ta 8 (tc’, tc”, a’, a”, u”, u”, pv”, pv”). All leg setae smooth and pointed.

**Type material** — Female holotype, slide ZISP T-Cal-01, Crimea, Arabat Spit, 45°17’54.0”N 35°28’19.0”E, 14 June 2021, moss on sandy soil, coll. A.A. Khaustov. Paratypes: 1 female, 1 larva, same data.

**Type deposition** — The holotype of the new species is deposited in the acarological collection of the Zoological Institute of RAS, St. Petersburg, Russia; paratypes are deposited in
Figure 4 Caligonella quinqueocellata n. sp., female: A–D – legs I–IV respectively, dorsal aspect.
Figure 5 DIC micrographs of *Caligonella quinqueocellata* n. sp., female: A – stylophore, dorsal aspect, B – anterolateral part of prodorsum. C – dorsal shield, D – genital area.

The mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

**Etymology** — The name of the new species is combined from two Latin words *quinque* meaning five and *ocellus* and refers to presence of five pairs of ocelli in female.

**Differential diagnosis** — The new species differs from all species of *Caligonella* in having five pairs of ocelli on prodorsum (only two in other species), The new species is most similar to *Caligonella scutovata* Smith-Meyer and Ueckermann described from South Africa (Smith-Meyer and Ueckermann 1989), by the presence of dorsal idiosomal shield and in having one pair of pseudanal setae. The new species differs from *C. scutovata* by the absence of ventral plate between coxae (present in *C. scutovata*) and location of setae *ve* on soft cuticle (*ve* located on dorsal shield in *C. scutovata*).
Genus *Molothrognathus* Summers and Schlinger, 1955

Type species: *Molothrognathus leptostylus* Summers and Schlinger, 1955, by original designation

*Molothrognathus tauricus* n. sp.

Zoobank: 1A3D7D07-6A22-4AB1-BD09-E44266190FC1

(Figures 9–15)

**Diagnosis** — Female. Dorsal shield present in space between setae *vi, ve* and *c1*; setae *sce* distinctly longer than other dorsal setae; setae *c2* much shorter than *sce* and subequal with *ve*; setae *ag3* absent.

**Description**

**Female** (Figs 9-11) — Length of idiosoma 320, width 185.

Idiosomal dorsum (Fig. 9A) — Ovate. Dorsal idiosomal stria thin, usually double; dorsal shield present, smooth, weakly sclerotized, ovate, and located in space between setae *vi, ve*, and...
c1. 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 d and ip laterad f. All dorsal idiosomal setae smooth and pointed; sce distinctly longer than other dorsal setae; setae ve, sci and c2 subequal, c1 slightly shorter than c2. Anal valves located dorsal; two pairs of pseudanal setae. Lengths of dorsal setae: vi 22, ve 18, sci 21, sce 44, c1 14, c2 20, d 16, e 20, f 19, h1 27, h2 26, ps1 7, ps2 10.

Idiosomal venter (Fig. 9B) – Ventral idiosoma without plate between coxae, striated. Coxal fields I-II and III-IV smooth. All ventral setae smooth and pointed. Two pairs of aggenital and one pair of genital setae; cupuli ih located posterolaterad ag2. Lengths of ventral setae: 1a 30, 1b 25, 1c 26, 2c 23, 3a 37, 3b 23, 4a 27, 4c 21, ag1 25, ag2 17, g 15.

Gnathosoma (Fig. 10) – Stylophore almost triangular (Fig. 10A), split distally, longitudinally striated, its length 82, width 46; peritremes tubular, typical for the genus; cheliceral stylets long, about three times longer than cheliceral levers. Palpal supracoxal setae (ep) located in deep depression with terminal pore; palpal chaetotaxy as in Caligonella quinqueocellata; tibial claw well developed, slightly hooked; all palpal setae smooth, eupathidia acmϛ, ul’ϛ, ul”ϛ, sulϛ blunt-tipped, other palpal setae pointed. Subcapitulum with few sparsely distributed puncta (Fig. 10B); all subcapitular setae smooth and pointed; lengths of subcapitular setae: m 35, or1 8, or2 9, length of palptarsal solenidion ω 5.

Legs (Fig. 11) – Lengths of legs: I 205, II 150, III 170, IV 200. Setation of legs as in Caligonella quinqueocellata. Leg I (Fig. 11A) longer than other legs. Supracoxal seta of leg I (el) located in deep depression with terminal pore; seta k of genu located in shallow depression; all leg setae smooth; setae (tc) and (p) eupathid-like, blunt-tipped, other leg setae pointed; solenidion ω 10 digitiform, solenidia φ 3 and øp 7 baculiform. Leg II (Fig. 11B). All leg setae smooth; seta p ’ϛ eupathid-like, blunt-tipped; other leg setae pointed; solenidion ω 4 digitiform.

Figure 7 Caligonella quinqueocellata n. sp., larva: A – gnathosoma, dorsal aspect, B – subcapitulum.
Figure 8 Caligonella quinqueocellata n. sp., larva: A-C – legs I-III respectively, dorsal aspect.

Figure 9 Molothrognathus tauricus n. sp., female: A – idiosomal dorsum, B – idiosomal venter.

Leg III (Fig. 11C). All leg setae smooth and pointed. Leg IV (Fig. 11D). All leg setae smooth and pointed.

Protonymph (Figs 12, 14C) — Length of idiosoma 250–275, width 155–160.

Idiosomal dorsum (Fig. 12A) — completely striated, without distinct dorsal shield, with oval area with very thin stria anteriad cl. Dorsal setae and cupuli as in female. Anal opening terminal. Lengths of dorsal setae: vi 18, ve 17, sci 17, sce 46, cl 15, c2 19, d 17, e 18, f 20, h1 33, h2 35, ps1 8, ps2 8.

Idiosomal venter (Fig. 12B) – Ventral idiosoma completely striated. Coxal field I–III as in female; coxal fields IV without setae; one pair of aggenital setae. All ventral setae smooth and pointed; cupuli ih located anteriad h2. Lengths of ventral setae: 1a 24, 1b 22, 1c 22, 2c 17, 3a 34, 3b 17, ag 18.

Gnathosome – as in female. Length of stylophore 69, width 40, lengths of setae: m 24, or1 7, or2 7, length of palptarsal solenidion ω 4.

Legs (Fig. 14C) – Lengths of legs: I 175, II 130, III 150, IV 165. Setation of legs I–III as in female. Leg I longer than other legs. Solenidion ω 8 digitiform, solenidia φ 3 and φp 6.

baculiform. Leg II. Solenidion ω 4 digitiform. Leg IV (Fig. 14C). Leg setation: Tr 0, Fe 1 (ev'), Ge 1 (v'), Ti 4 (d, l", v", v"), Ta 8 (te', te", a', a", u', pv', pv''). All leg setae smooth and pointed.

Larva (Figs 13, 14A, B, 15) — Length of idiosoma 235, width 135.

Idiosomal dorsum (Fig. 13A) – completely striated, without dorsal shield. Anal opening terminal. Lengths of dorsal setae: vi 21, ve 17, sci 19, sce 78, eI 20, e2 57, d 17, e 25, f 38, h1 49, h2 35, ps 7, ps2 8.

Idiosomal venter (Fig. 13B) – Ventral idiosoma similar with that of protonymph, except absence of setae 2c, 3b and ag1. Lengths of ventral setae: 1a 25, 1b 26, 3a 35.

Gnathosoma (Fig. 14A, B) – in general similar to that of female except following: subcapitulum without seta m (Fig. 14A), palpatarsus with setae acm and sul simple (not eupathidia) (Fig. 14B). Length of stylophore 60, width 33, lengths of setae: or1 7, or2 8, length of palptarsal solenidion ω 3.

Legs (Fig. 15) – Lengths of legs: I 165, II 125, III 145. Setation of legs as in larva of Caligonella quinqueocellata, except absence of seta p” on tarsus II. Leg I (Fig. 15A) longer than other legs. All leg setae smooth; setae (p) eupathid-like, blunt-tipped, other leg setae pointed; solenidion ω 7 digitiform, solendia φ 3 and φp 6 baculiform. Leg II (Fig. 15B). All leg setae smooth and pointed; solenidion ω 5 digitiform. Leg III (Fig. 15C). All leg setae smooth and pointed.

Type material — Female holotype, slide ZISP T-Cal-02, Crimea, Aeabat Spit, 45°17'54.0"N 35°28'19.0"E, 14 June 2021, moss on sandy soil, coll. A.A. Khaustov. Paratypes: 1 larva, 2
Figure 11 *Molothrognathus tauricus* n. sp., female: A-D – legs I-IV respectively, dorsal aspect.
protonymphs, same data.

**Type deposition** — The holotype and 2 protonymph paratypes of the new species are deposited in the acarological collection of the Zoological Institute of RAS, St. Petersburg, Russia; other paratype is deposited in the mite collection of the Tyumen State University Museum of Zoology, Tyumen, Russia.

**Etymology** — The name of the new species refers to its distribution in Crimea.

**Differential diagnosis** — The female of the new species is most similar to *Molothrognatus crucis* Summers and Schlinger, 1955, described from USA (Summers and Schlinger 1955) and redescribed from Turkey (Doğan 2003), and *M. mikaeeli* Bagheri and Ahamazad, 2012, described from Iran (Ahanazad and Bagheri 2012), by the absence of setae *ag*3, and setae *c*2 subequal with *c*1 and *ve* and distinctly shorter than *sce*. The new species differs from *M. mikaeeli* by the presence of dorsal idiosomal shield (absent in *M. mikaeeli*). The new species differs from *M. crucis* in having dorsal idiosomal shield much shorter, its posterior margin not exceeding beyond bases of setae *c*1 and oval in shape (dorsal idiosomal shield very long,
tongue-shaped, its posterior margin exceeding beyond bases of setae d in *M. crucis* and by distinctly shorter setae sce, which about twice longer than c2 (sce much longer, about three times longer than c2 in *M. crucis*). The female of the new species is also similar to *M. shirazicus* Khanjani, Bakhshi and Khanjani, 2016, described from Iran (Khanjani et al. 2016) and *M. colei* Swift, 1996, described from Hawaii (Swift 1996), by the similar shape of dorsal idiosomal shield. The new species differs from both species by the absence of setae ag3 (present in *M. shirazicus* and *M. colei*). The new species differs from *M. shirazicus* in having setae c2 subequal with ve and sci (c2 distinctly longer than ve and sci in *M. shirazicus*). The new species differs from *M. colei* in having setae c2 twice shorter than sce (c2 and sce subequal in *M. colei*).

**Discussion**

The genera *Caligonella* and *Molothrognathus* are the most derived group of Caligonellidae (Fan 2000) and very similar morphologically. The only difference between genera is position

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**Figure 13** *Molothrognathus tauricus* n. sp., larva: A – idiosomal dorsum, B – idiosomal venter.
of anterior end of peritremes. In *Caligonella* anterior end of peritremes situated anteroventrally and in *Molothrognathus* dorsomedially on stylophore. The discovery of larval stages of *Caligonella quinqueocellata* and *Molothrognathus tauricus* and description of their legs shows more derived leg setation in comparison to more primitive genus *Coptocheles* (Swift 2001). The only difference between larval legs setation in *Caligonella quinqueocellata* and *Molothrognathus tauricus* is the absence of seta *p"* on tarsus II in *M. tauricus*. The chaetotaxy of palptarsus in larval stage of Caligonellidae has never been described. In both described species, palptarsus of larva has the same number of setae as adults. However, setae *acm* and *sul* are not modified (not eupathid-like). In contrast to more early derivative genus *Neognathus*,

Figure 14 *Molothrognathus tauricus* n. sp., larva: A – subcapitulum, B – palptarsus, ventral aspect; protonymph: C – leg IV, dorsal aspect.
Figure 15 Molothrognathus tauricus n. sp., larva: A-C – legs I-III respectively, dorsal aspect.

palptarsus of Caligonella and Molothrognathus lacks seta \( l_p \).

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