

Description of *Orthadenella coulsoni* sp. nov. (Acari: Mesostigmata: Melicharidae) from Siberia with a key to the females of *Orthadenella*

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This paper presents both the description and the iconographic documentation of a mite species new to science: *Orthadenella coulsoni* sp. nov., recorded from Siberia, Russia. A key for determining females of all species within this genus is included.

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Introduction

The genus *Orthadenella* was described originally by Athias-Henriot (1973) who established the genus *Proctolaelaps (Neojordensia) lawrencei* described by Evans (1958). Although Athias-Henriot in her elaborate paper (1973) distinguished between genera *Orthadenella* and *Neojordensia*, in subsequent works this proposal was disregarded, thus the previous classification structures have remained (Bregetova 1977; Karg 1993; Gwiazdowicz 2007).

Christian and Karg (2006) in their monograph elaborate on the genus *Lasioseius*, placed *Lasioseius lawrencei* in the subgenus *Lasioseius* s. str., within a group labelled as *Lasioseius-berlesei*-complex. Some changes were made along with a new classification proposed by Lindquist et al. (2009) in which attention was paid to the two species of the genus *Orthadenella*. Lindquist and Moraza (2010) revised the differential characters of the Blattisociidae, and provided a key to the genera, placing *Orthadenella* within this family. In the next paper the same authors removed *Orthadenella* from the family Blattisociidae and transferred it to the family Melicharidae (Moraza and Lindquist 2011).

At present two species of *Orthadenella* are known; *Orthadenella lawrencei* (Evans 1958) and *O. tennesseensis* (De Leon 1963). Unfortunately, the biology and ecology of these are poorly known. Previously, *O. lawrencei* was recorded from many European countries occurring in microhabitats such as forest litter, humus, moss on soil and on tree trunks and rotting wood (Gwiazdowicz 2007). The latter species, *O. tennesseensis*, is recorded in North America in moss, hardwood logs, pine trees attacked by scolytid bark beetles, and bracket fungi (De Leon 1963; McGraw and Farrier 1969).

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Materials and methods

Nineteen females and eight males of an undescribed species belonging to the genus *Orthadenella* were found in litter from the Altai Mountains in the southern Siberia, Russia.

Mites were removed from litter and soil samples by the Tullgren funnel extraction method, and preserved in 70% ethanol. These were mounted in Hoyer's medium on glass slides for identification and sealed with a nail polish. All figures were drawn using a Zeiss Axioskop 2 microscope (Carl Zeiss AG, Jena, Germany). Morphological details were measured as follows: setal length from base to tip, shield length along midline and width at the widest point of the shield. All measurements are in micrometres (μm). The chaetotaxy, symbols and the numbering system of setae on the dorsal and ventral side are after Evans (1963), Lindquist and Evans (1965) and Lindquist (1994). The idiosomal adenotaxy and poroidotaxy are based on Johnston and Moraza (1991).

The holotype, four paratypes of females and four paratypes of males are deposited in the Siberian Zoological Museum in Novosibirsk, Russia; 14 paratypes of females and four paratypes of males are deposited in Natural History Museum in London, UK.

Systematics

Family **MELICHARIDAE** Hirschmann

Genus *Orthadenella* Athias-Henriot, 1973

Type species: *Proctolaelaps (Neojordensia) lawrencei* Evans, 1958

Synonyms: *Lasioseius berlesei* Oudemans *sensu* Westerboer;
Lasioseius frondeus Karg.

Diagnosis of genus

Dorsal side. Idiosoma with a holodorsal shield, 11 pairs of marginal *r*-*R* setae on edge of dorsal shield, the opisthonotal region of shield with 20 pairs of setae, seta *zI* present.

Ventral side. One or two pairs of presternal platelets, sternal shield with three pairs of simple setae, one pair of metasternal platelets, ventrianal shield, one or two pairs of metapodal platelets, endopodal shields alongside coxae III-IV are strongly developed, and are contiguous or connected with the endopodal portions of the sternal shield alongside coxae II, peritrematal shields connected with a continuous, unfragmented exopodal strips alongside coxae IV; spermathecal apparatus with two branches of tubulus annulatus, unpaired sacculus foeminus, and narrow sperm duct; sacculus walls with many thin filaments or cylindrical protrusions.

Gnathosoma. Corniculi well separated, stout; deutosternal groove with rows, each with 2-6 denticles; movable cheliceral digit with three denticles, fixed digit with a ridge extending from paraxial surface to 3 denticles on proximoventral surface, bears a setiform pilus dentilis, instead of the modified hyaline process typical for the great majority of melicharids; epistome convex or triramous, denticulate.

Legs. Setation of trochanter I (6 setae), femora I (12), II (11), III (7), IV (6), genua I (13), II (11), III (9), IV (9), tibiae I (13), II (10), III (8), IV (9).

***Orthadenella coulsoni* sp. nov.**
(Figures 1, 2, 3A–G, 4A–D, 5, 6A–D)

Type material

Holotype. Female, North Altai (51° 30' N, 85° 02' E), 700 m asl, Shebalino District, *Larix sibirica* forest, on the hillside, in litter, 17 August 2011, coll. I.I. Marchenko.

Paratypes. Two females, the same data as holotype; 11 females, North Altai (51° 08' N, 85° 34' E), 1200 m asl., Shebalino District, environs of Topuchaja village, swamped forest of *Picea sibirica*, in litter, 10 June 1999, coll. I.I. Marchenko; five females and eight males, Central Altai (50° 12' N, 88° 03' E), Kurai Ridge foothills, 2000 m asl., floodplain river Kuraika, shrub, in litter, 16 July 1964, coll. S.K. Stebaeva.

Diagnosis

Female ($n = 19$). Idiosoma oval, 400–420 μm in length and 225–240 μm in width.

Dorsal. Holodorsal shield bearing 43 pairs of simple setae and among them 20 are situated on the opisthonotal posterior part. The shortest setae are given (in μm): j_2 (7–8), j_3 (10–11), z_1 (5–7), z_2 (10–12), s_1 (6–7), J_5 (7–10); the longest are those labelled j_1 (20–22), Z_5 (38–41), Z_4 (25–26), S_4 (25–27) and S_5 (25–27). Other seta in j , z and s rows, on the podonotal part, are of a median length from 12 to 17 μm and are as follows: j_4 (13–15), j_5 (15–17), j_6 (15–17), z_3 (12–15), z_4 (12–15), z_5 (12–15), z_6 (12–15), s_2 (10–12), s_3 (12–15), s_4 (12–15), s_5 (12–15), s_6 (12–15), and slightly longer in J , Z and S rows, on the opisthonotal part, from 15 to 22 μm , consecutively: J_1 (15–17), J_2 (15–17), J_3 (15–17), J_4 (20–22), Z_1 (15–17), Z_2 (15–17), Z_3 (15–17), S_1 (17–22), S_2 (17–22), S_3 (17–22). All setae in the marginal row r – R are located on the shield, none on the soft membrane. They range in length in a row r from 15 to 17 μm , r_2 (15–17), r_4 (15–17), r_5 (15–17), r_6 (15–17), excepting humeral setae $r_3 = 21 \mu\text{m}$, and in row R are about 17 to 20 μm as given: R_1 (17–20), R_2 (17–20), R_3 (17–20), R_4 (17–20), R (17–20). Setae r_2 – R_5 at clearly delineated marginal strip. Holodorsal shield is more or less conspicuously covered with a reticulate ornamentation (Figure 1).

Ventral. The tritosternum with base 10–11 μm wide and 14–15 μm long with laciniae 57–62 μm long (excluding base) with a fused area, free area for about 0.7 of total length (Figure 3A). Anteriorly to the sternal shield lie two pairs of small presternal platelets. Outer platelets are smaller (5–7 \times 3 μm) than the inner ones (11–15 \times 5 μm). Sternal shield reaches 90–92 μm in length at the midline, and 120–130 μm in width at the widest point, that is, at a level between the first and the second coxae. It bears three pairs of simple setae totally, of lengths: st_1 (23–25 μm), $st_2 = st_3$ (17–20 μm). As well as pair of gland pores gst_1 at the extensions between coxae I–II and two pairs of

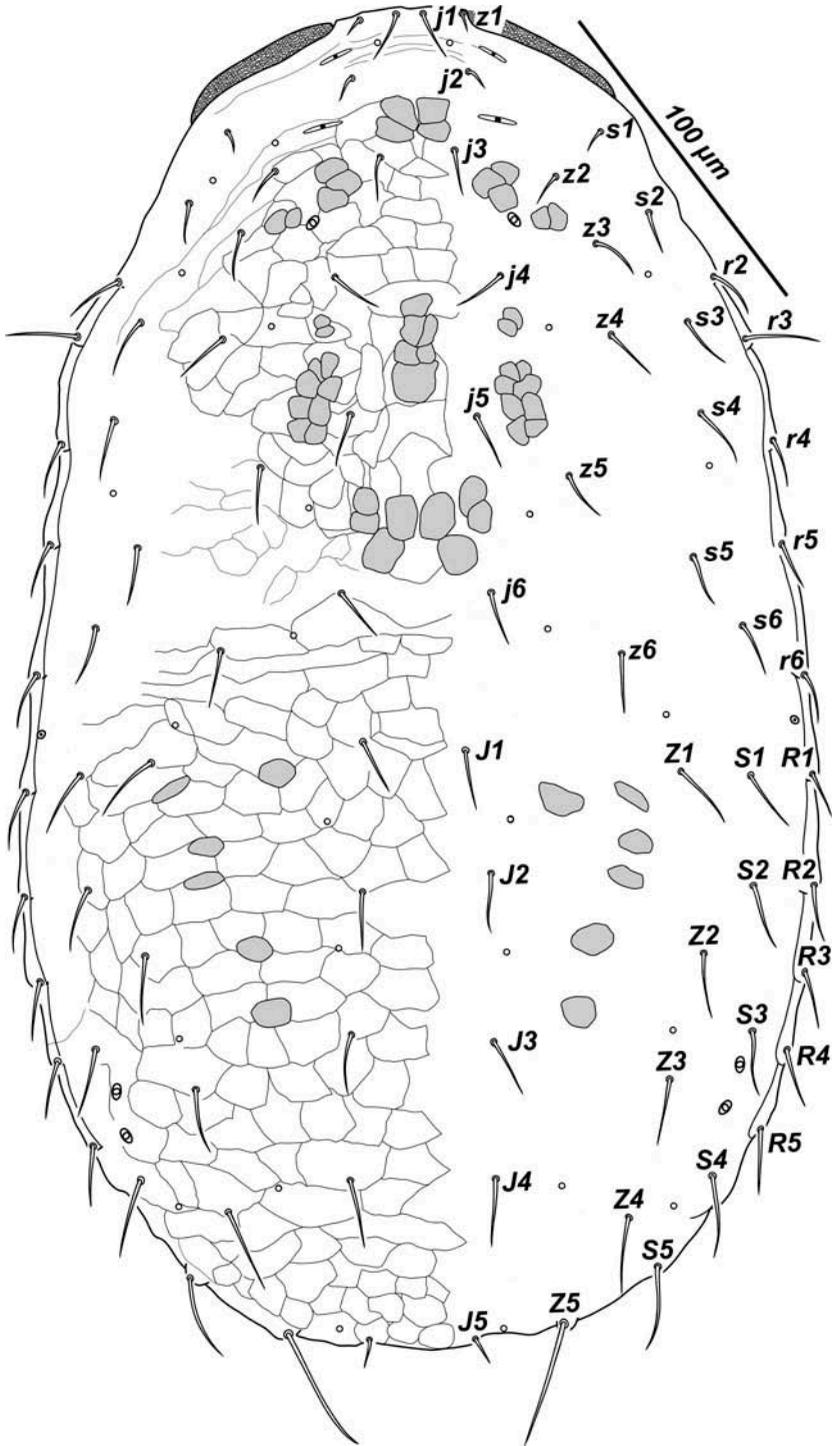


Figure 1. *Orthadenella coulsoni* sp. nov., female: dorsal view of idiosoma.

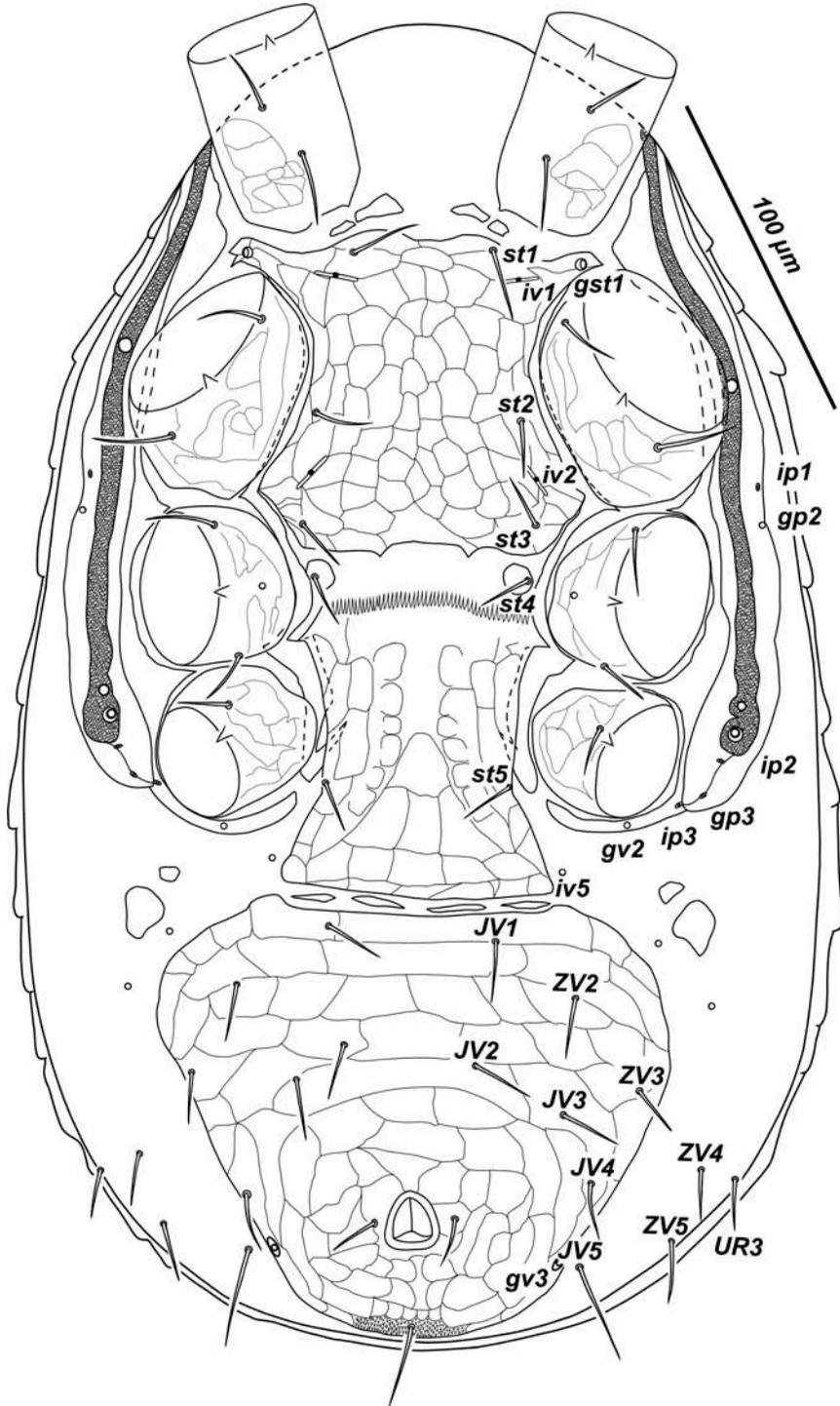


Figure 2. *Orthadenella coulsoni* sp. nov., female: ventral view of idiosoma.

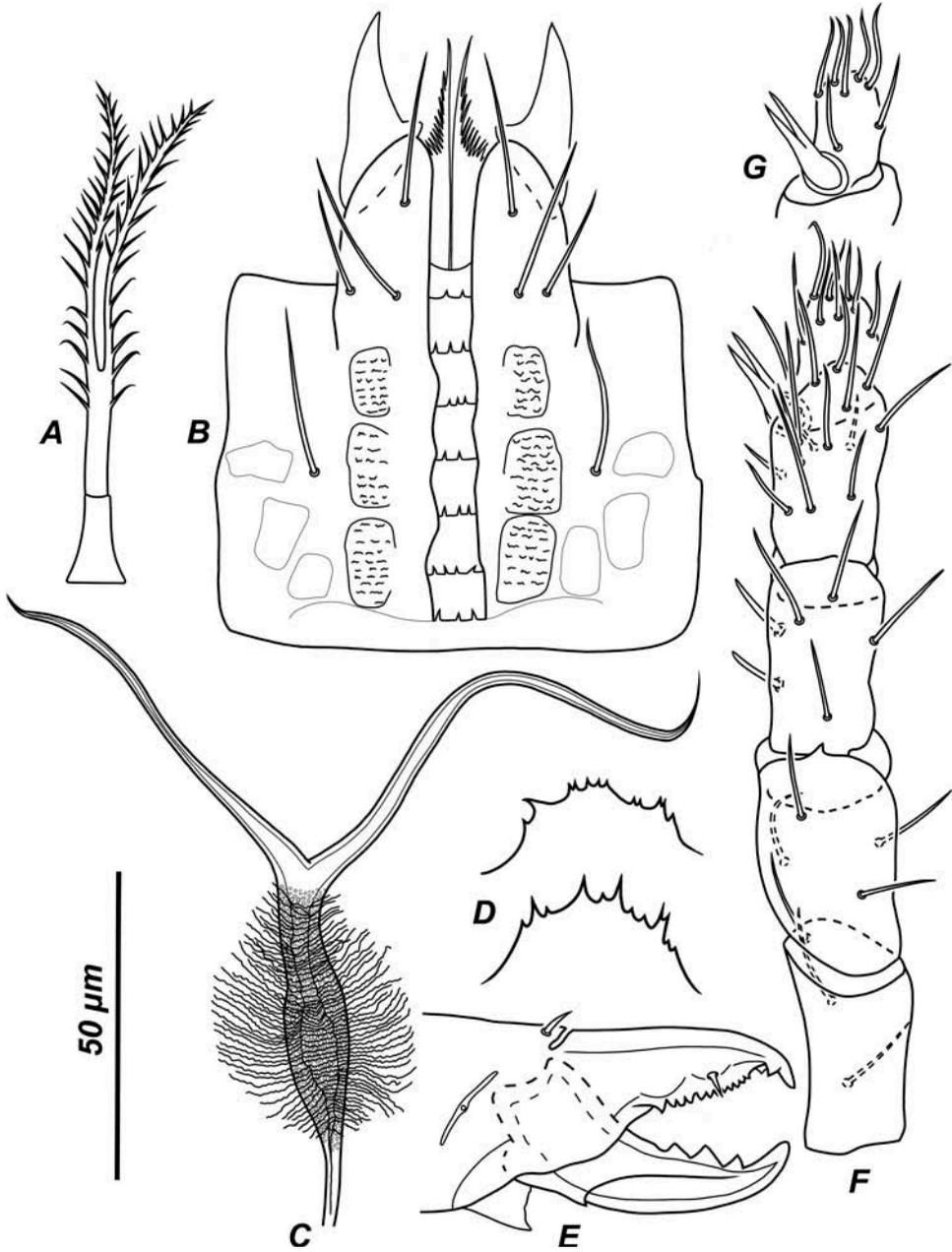


Figure 3. *Orthadenella coulsoni* sp. nov., female: (A) tritosternum; (B) gnathosoma; (C) sperm access system; (D) epistomes; (E) chelicera; (F) dorsal of palptarsus; (G) ventral of palptarsus.

lyrifissures *iv1*, *iv2*, but the third pair of sternal lyrifissures *iv3* is absent either on the sternal shield nor metasternal shields. Posteriorly to the sternal shield are small rounded metasternal shields ($10 \times 10 \mu\text{m}$), with a setae *st4* ($19\text{--}20 \mu\text{m}$) on it. Inner to coxae II–IV are archwise endopodal shields embracing the coxae, underlying an

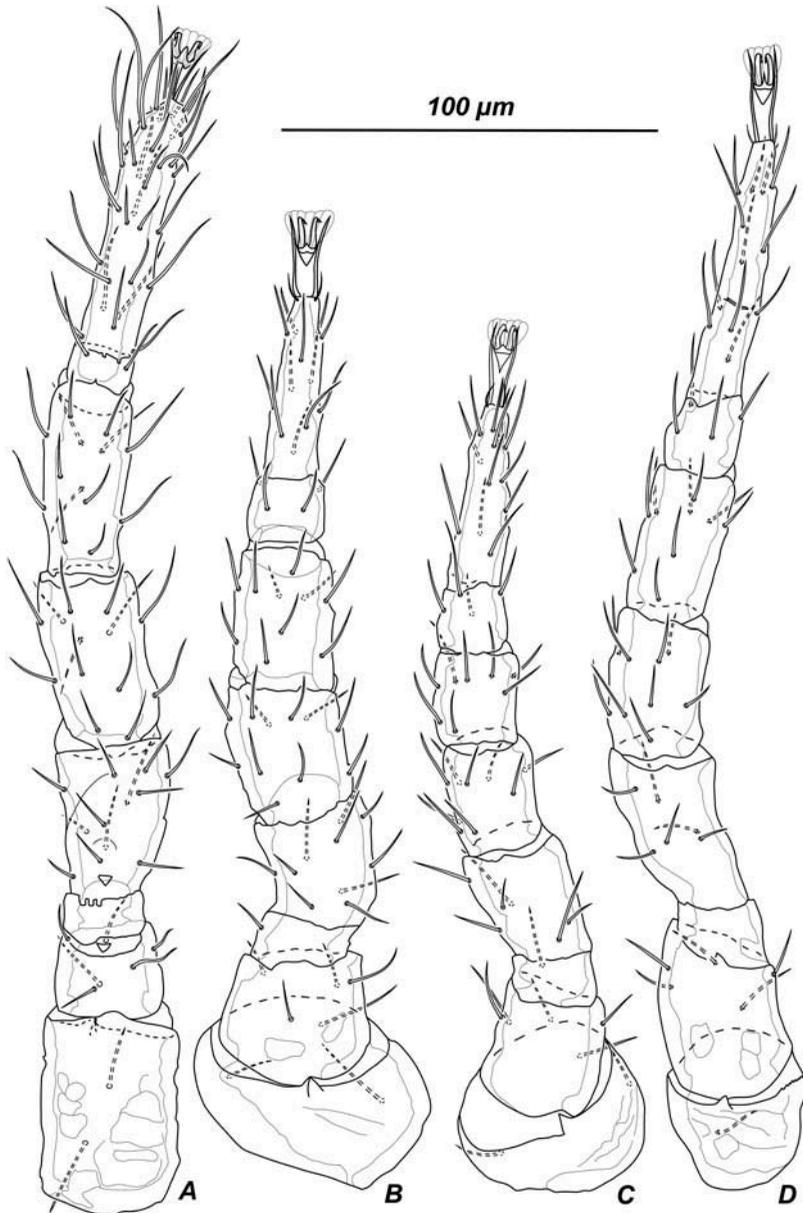


Figure 4. *Orthadenella coulsoni* sp. nov., female: (A) leg I; (B) leg II; (C) leg III; (D) leg IV.

epigynal shield and partially fused to it. Epigynal shield broad (82–88 μm), and almost of the same length (*c.*90 μm at the midline), truncate, with a pair of setae *st5* (15–20 μm). Paragenital poroids *iv5* are located outside the epigynal shield. Four scanty sclerites arranged in a one line are located posterior to an epigynal shield. Heart-shaped ventrianal shield 145–150 μm length and 155–165 μm width with 15 setae. The shortest are the para-anal setae (13–15 μm), noticeably longer is the

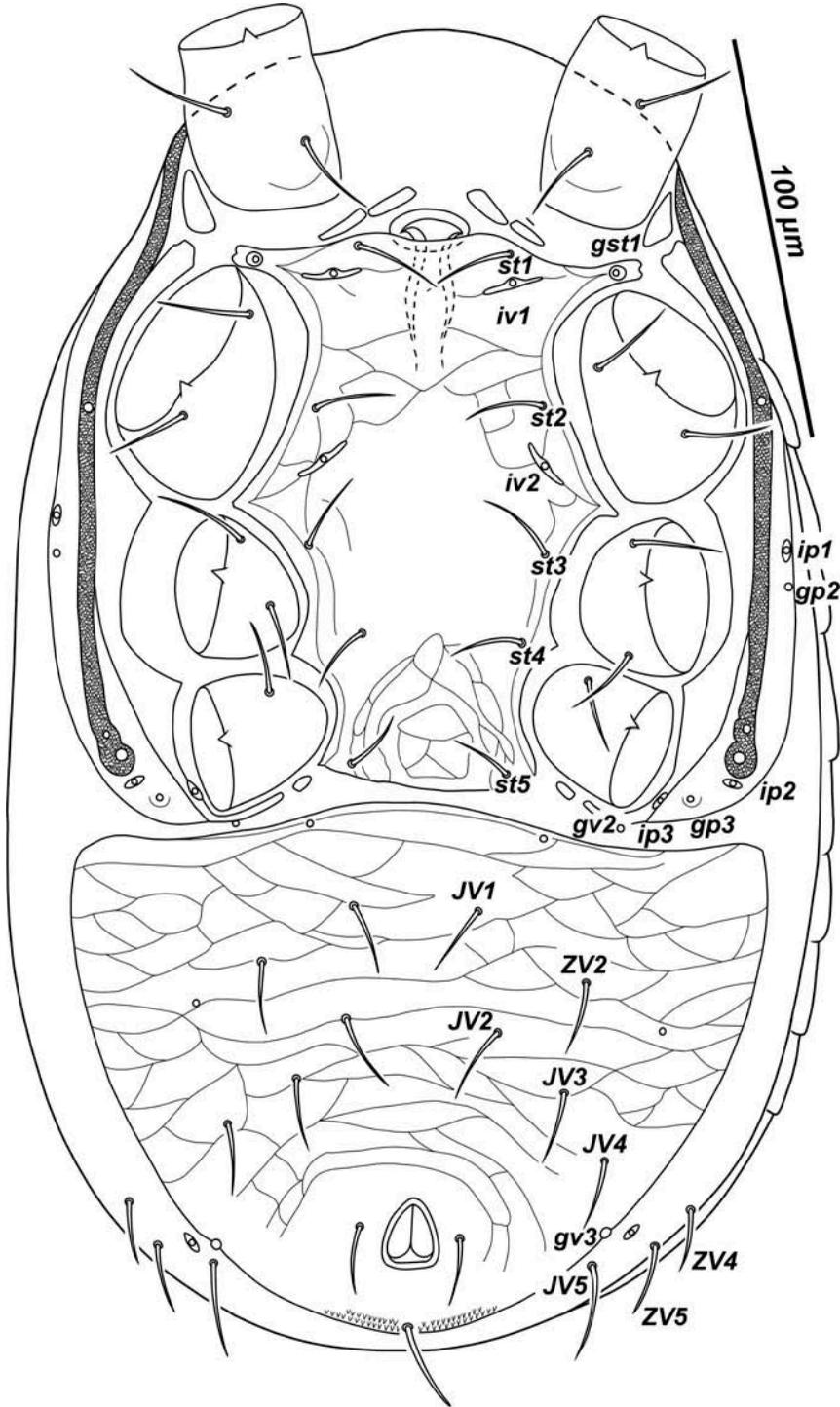


Figure 5. *Orthadenella coulsoni* sp. nov., male: ventral view of idiosoma.

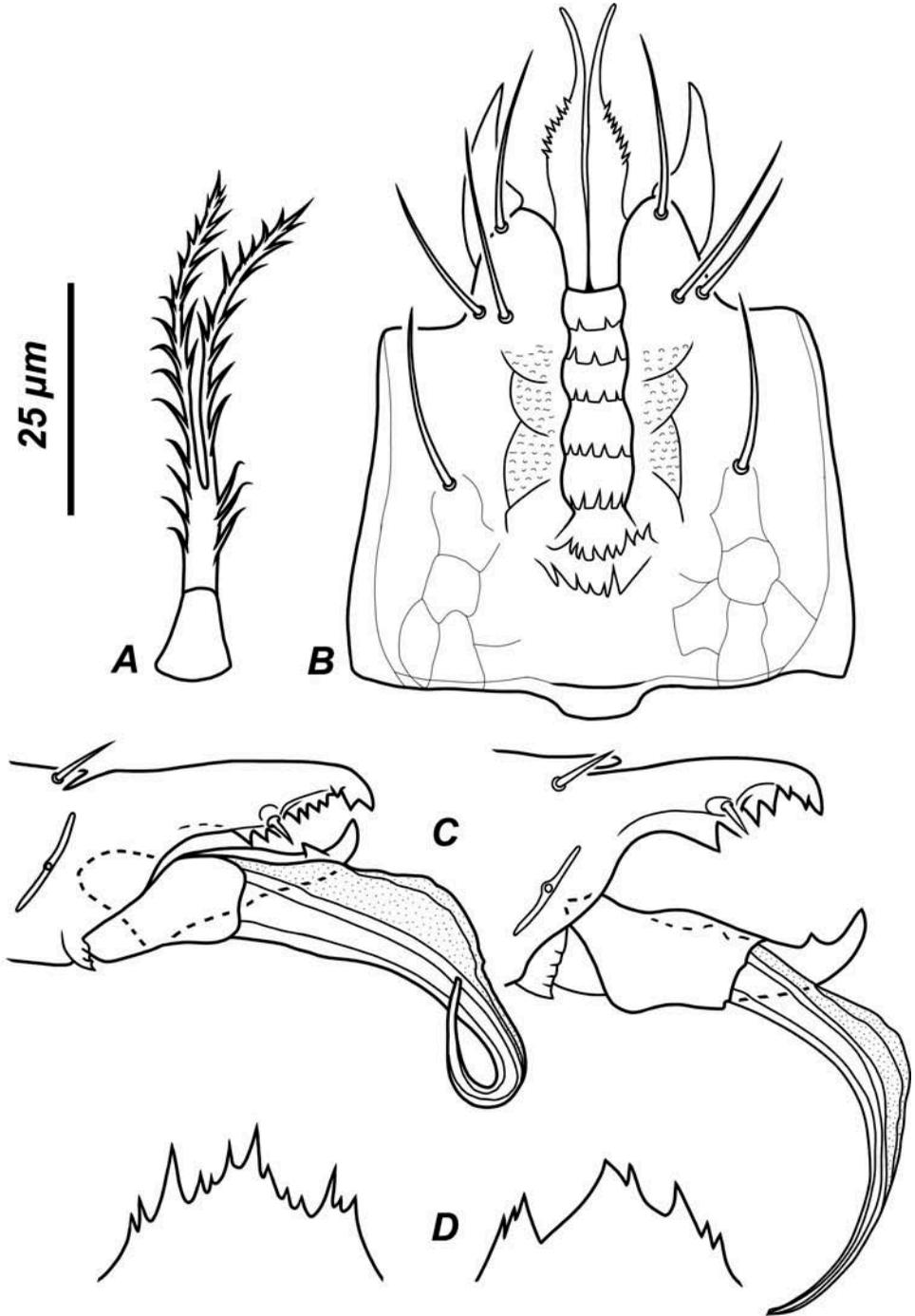


Figure 6. *Orthadenella coulsoni* sp. nov., male: (A) tritosternum; (B) gnathosoma; (C) chelicerae; (D) epistomes.

postanal seta (24–25 µm) and ventral setae ranging from 18 µm to 21 µm as given (in µm): *JV1* (18–21), *JV2* (18–21), *JV3* (18–21), *JV4* (18–21), *ZV2* (18–21) except shorter *ZV3* (15–17). Likewise, the sternal, genital and ventrianal shields are covered with a reticulate ornamentation (Figure 2). Outside the ventrianal shield remain four pairs of simple setae (including *UR3* = 17–20 µm) *JV5* (28–30), *ZV4* (16–20), *ZV5* (20–21). Peritremes long, reaching above the coxae I, stigmata at the level of coxae IV. Peritrematal shields narrow, connected with an exopodal strip alongside coxae IV. Peritrematal–exopodal shields fused, with poroids *ip1*, *ip2*, *ip3* and pores *gp2*, *gp3*, *gv2*. Posterolaterally to the coxae IV on each side arise two pairs of metapodal sclerites. Those proximal to the coxae IV are smaller (4–6 × 4–6 µm), than further ones (20–21 × 11–13 µm). Sperm access system is that of a Laelapid type, with a sacculus comprised of a thick and porous layer with a numerous thin filaments (Figure 3C).

Gnathosoma. Corniculi are elongated, 26–30 µm long and 10 µm wide; seven rows of denticles are located in the hypostomatal groove (2–6 denticles per row); hypostomatal setae are simple of variable length: *h1*–20–21 µm, *h2*–21–22 µm, *h3*–14–16 µm, *h4*–22–24 µm (Figure 3B). Internal malae as long as corniculi, with a fringed laterobasal margins. Epistome with anterior margin irregularly convex, finely denticulate (Figure 3D). Cheliceral fixed digit 38–40 µm long with a stout pilus dentilis; masticatory surface with a row of 12 teeth and two subapical teeth in addition to apical tooth. Cheliceral movable digit (37–39) tridentate in addition to apical hook; with a transverse-diagonal groove, which appears on the basal one-third of ventral side of chelicera. Dorsal cheliceral seta, dorsal and lateral (antiaxial) lyrifissure distinct (Figure 3E). Palps 126–128 µm long (Figure 3F, G).

Legs. Variable in length: I – 320–340 µm, II – 250–260 µm, III – 240–250 µm, IV – 315–325 µm. Chaetotaxy of legs is peculiar for genus *Orthadenella*: leg I: coxa, trochanter, femur, genu, tibia (2, 6, 12, 13, 13), leg II (2, 5, 11, 11, 10), leg III (2, 5, 7, 9, 8), leg IV (1, 4, 6, 9, 9) (Figure 4A, B, C, D).

Male (*n* = 8) Idiosoma oval, 330–355 µm in length and 212–222 µm in width.

Dorsal. Holodorsal shield bearing 43 pairs of simple setae, including 23 podonotal pairs (*j1*–*j6*, *z1*–*z6*, *s1*–*s6*, *r2*–*r6*) and 20 opisthonotal pairs (*J1*–*J5*, *Z1*–*Z5*, *S1*–*S5*, *R1*–*R5*). Dorsal shield lightly reticulate. Measurements of podonotal setae precisely (in µm): *j1* (12–15), *j2* (15–17), *j3* (12–15), *j4* (12–15), *j5* (12–15), *j6* (12–15), *z1* (8–10), *z2* (15–17), *z3* (12–15), *z4* (12–15), *z5* (12–15), *z6* (12–15), *s1* (12–15), *s2* (15–17), *s3* (12–15), *s4* (15–17), *s5* (12–15), *s6* (12–15), *r2*–*r6* (12–15). Measurements of opisthonotal setae as follows (in µm): *J1* (10–12), *J2* (10–12), *J3* (12–15), *J4* (15–17), *J5* (5–6), *Z1* (12–15), *Z2* (12–15), *Z3* (12–15), *Z4* (17–20), *Z5* (28–30), *S1* (12–15), *S2* (12–15), *S3* (12–15), *S4* (15–17), *S5* (17–20), *R1*–*R5* (12–15). Setae *r2*–*R5* at clearly delineated marginal strip, likewise for female.

Ventral. Tritosternum with base 7–10 µm wide and 12–15 µm long with laciniae 42–47 µm long (excluding base) with a fused area, free area for about 0.7 of total length (Figure 6A). Presternal area with a pair platelets. Peritrematal shields and peritremes as in female (poroids *ip1*, *ip2*, *ip3* and pores *gp2*, *gp3*, *gv2* are present). Sternitigenital shield 137–145 µm long and 100–113 µm wide at level between coxae II–III; finely

ornamented anteriorly between setae *st1* and *st3*, posteriorly between *st4* and *st5*, and lineate along lateral margins. Sternal shield with a pair of gland pores *gst1* at extensions between coxae I–II and with two pairs of lyrifissures *iv1*, *iv2*. Shields with five pairs of setae. Measurements of sternal setae as given (in μm): *st1* (20–21), *st2* (18–20), *st3* (16–18), *st4* (15–16), *st5* (14–15). Ventrianal shield ornamented, mid-length (130–145 μm), greatest at midlateral width (155–170 μm) at the level of seta *JV1*, with a regularly convex lateral margins, bearing five opisthogastric setae *JV1* (14–15), *JV2* (15–17), *JV3* (14–15), *JV4* (14–15 μm), *ZV2* (14–15), pair of circum-anal setae (14–15) and post-anal seta 20 μm ; bearing two pairs of poroids and pair of pores *gv3*; soft opisthogastric cuticle stays with three pairs of setae *JV5* (20), *ZV4* (13–14), *ZV5* (14–15). Opisthogastric setae *ZV3* and *UR3* are absent contrary to female (Figure 5).

Gnathosoma. Deutosternum with seven rows of denticles; margins of deutosternal groove delineated laterally except posteriormost row. Number of denticles in each row varies individually in specimens: the first posteriormost row (5–9 denticles), the second row (8–12), the third row (5–6), the fourth row (4–5), 5–7 rows (2–4 in each row). Subcapitulum with a hypostomatic setae *h1* (20–22), *h2* (15–17), *h3* (20–22), *h4* (20–22); with three pockmarked delineated areas between *h2*–*h3* and palpcoxal seta *h4*. Form of corniculi as in female, 22 μm long and 7–8 μm width; internal malae longer than corniculi, with fringed lateral margins basally (Figure 6B). Cheliceral fixed digit 30–32 μm long with a stout pilus dentilis and usually with six teeth in addition to apical tooth: two large basal teeth and two smaller medium-sized teeth at a masticatory surface and two subapical teeth. Cheliceral fixed digit of one sample (eighth examined sample) with nine teeth: three large basal teeth, four medium-sized teeth at masticatory surface and two subapical teeth in addition to apical tooth. Movable digit (28–30 μm) with one tooth in addition to an apical tooth. Spermatodactyl 43–45 μm long with a hyaline ridge above internal canal along its entire length (Figure 6C). Dorsal cheliceral seta, dorsal and lateral (antiaxial) lyrifissure distinct. Epistome with an anterior margin irregularly convex, finely denticulate (Figure 6D).

Legs. Variable in length: I – 260–290 μm , II – 215–225 μm , III – 200–210 μm , IV – 260–290 μm . Leg structure and setation as in female.

Etymology

The species is dedicated to our friend, a scientist exploring the invertebrate fauna of the High Arctic, Prof. Dr Stephen J. Coulson from University Centre in Svalbard. Longyearbyen, Norway.

Differential diagnosis

The morphometric analysis of *O. coulsoni* shows many different diagnostic characters from the other two species of *Orthadenella*. Even a simple analysis of setae measurements gives both similarities (the same lengths of setae *Z4*, *Z5*, and setae *J1*, *J2*, *J3*, *J4*, *Z1*, *Z2* longer by 6–7 μm , and vertical *j1* shorter by 4 μm) and dissimilarities when compared to *O. tennesseensis*. A shared character between *O. coulsoni* and *O. lawrencei* is a marked dorsal reticulated patterning covering almost the whole shield, while in *O. tennesseensis*,

this is reticulated only on the posterior and anterior border. Moreover, *O. coulsoni* and *O. lawrencei* have a humeral seta *r*3 conspicuously longer than the remaining setae in the marginal row *r*–*R*, which *O. tennesseensis* does not. This character is repeated in the *S*4, *S*5 and *Z*5 pairs of setae. However, *O. lawrencei* setae *Z*4 are identical to the *Z*1–*Z*3 setae, whereas in *O. coulsoni* these setae are dissimilar. In addition, the location of pore *iv*5 is a further diagnostic character. This pore lies outside the genital shield of both *O. coulsoni* and *O. tennesseensis* but, as is more common, on the shield in *O. lawrencei*. A very fine character separating the species is the appearance of a ventrianal shield. This has a characteristic concave anterior boarder at the level between the genital and metapodal sclerites for the entire genus, but differs in shape among species. That of *O. coulsoni* is wider than long, contrary to the other species. Likewise, the difference in the number of setae located on the ventrianal shield, excluding a circum-anal setae, is another significant character, differentiating *O. tennesseensis*, with five pairs, from the two remaining species, each bearing six pairs. The metapodal shields in the opistogastric region clearly distinguish *O. lawrencei* which possesses only a single pair, while *O. coulsoni* has two pairs composed of the larger sclerite with a smaller abutting. The epistome of *O. tennesseensis* and *O. lawrencei* is a trispinate, median process broadly triangular and extending beyond the apex of the lateral processes, contrary to *O. coulsoni*, which has convex epistome with homogenous denticles arranged parallel to each other. The spermatheca of *O. lawrencei* is composed of a sacculus permeated with numerous pores and cylinders, while the spermatheca of *O. coulsoni* is permeated with numerous pores and thin filaments.

Key to the females of genus *Orthadenella*

Information concerning *O. lawrencei* and *O. tennesseensis* was obtained from published descriptions and illustrations (Evans 1958; De Leon 1963; McGraw and Farrier 1969; Moraza and Lindquist 2011).

1. Only one metapodal plate on each side of the body behind coxae IV
..... *O. lawrencei* (Evans 1958)
- Metapodal plates divided into two small plates 2
2. Interscutal setae *JV*4 outside ventrianal shield, length and width of ventrianal shield similar *O. tennesseensis* (De Leon 1963)
- Interscutal setae *JV*4 on ventrianal shield, ventrianal shield wider than long
..... *O. coulsoni* n. sp.

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