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

Dariusz J. Gwiazdowicz\ a*, Irina I. Marchenko\b  and Ewa Teodorowicz\ a

\ aFaculty of Forestry, Poznan University of Life Sciences, Poznan, Poland; \ bInstitute of Systematics and Ecology of Animals, Russian Academy of Sciences, Novosibirsk, Russia

(Received 24 February 2014; accepted 6 October 2014; first published online 6 November 2014)

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.

http://zoobank.org/urn:lsid:zoobank.org:pub:3B416529-A22D-43B3-96BD-3D5A8ED4F0F1

Keywords: mites; Gamasina; Altai; Russia; new species

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).

*Corresponding author. Email: dagwiazd@up.poznan.pl*

© 2014 Taylor & Francis
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 MELICHRARIDAE 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 z1 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): j2 (7–8), j3 (10–11), z1 (5–7), z2 (10–12), sl (6–7), J5 (7–10); the longest are those labelled j1 (20–22), Z5 (38–41), Z4 (25–26), S4 (25–27) and S5 (25–27). Other setae in j, z and s rows, on the podonotal part, are of a median length from 12 to 17 µm and are as follows: j4 (13–15), j5 (15–17), j6 (15–17), z3 (12–15), z4 (12–15), z5 (12–15), z6 (12–15), s2 (10–12), s3 (12–15), s4 (12–15), s5 (12–15), s6 (12–15), and slightly longer in J, Z and S rows, on the opisthonotal part, from 15 to 22 µm, consecutively: J1 (15–17), J2 (15–17), J3 (15–17), J4 (20–22), Z1 (15–17), Z2 (15–17), Z3 (15–17), S1 (17–22), S2 (17–22), S3 (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, r2 (15–17), r4 (15–17), r5 (15–17), r6 (15–17), excepting humeral setae r3 = 21 µm, and in row R are about 17 to 20 µm as given: R1 (17–20), R2 (17–20), R3 (17–20), R4 (17–20), R (17–20). Setae r2–R5 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 prestenal platelets. Outer platelets are smaller (5–7 × 3 µm) than the inner ones (11–15 × 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: st1 (23–25 µm), st2 = st3 (17–20 µm). As well as pair of gland pores gst1 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.
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 × 10 µm), with a setae *st4* (19–20 µm) on it. Inner to coxae II–IV are archwise endopodal shields embracing the coxae, underlying an
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 4. Orthadenella coulsoni sp. nov., female: (A) leg I; (B) leg II; (C) leg III; (D) leg IV.
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 denticate (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, RI-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), RI-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). Sterntigenital 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 j/j shorter by 4 µm) and dissimilarities when compared to O. tenesseensis. A shared character between O. coulsoni and O. lawrencei is a marked dorsal reticulated patterning covering almost the whole shield, while in O. tenesseensis,
this is reticulated only on the posterior and anterior border. Moreover, *O. coulsoni* and *O. lawrencei* have a humeral seta r3 conspicuously longer than the remaining setae in the marginal row r–R, which *O. tennesseensis* does not. This character is repeated in the S4, S5 and Z5 pairs of setae. However, *O. lawrencei* setae Z4 are identical to the Z1–Z3 setae, whereas in *O. coulsoni* these setae are dissimilar. In addition, the location of pore iv5 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 JV4 outside ventrianal shield, length and width of ventrianal shield similar ......................................................... *O. tennesseensis* (De Leon 1963)
   – Interscutal setae JV4 on ventrianal shield, ventrianal shield wider than long ......
   .................................................................................................................... *O. coulsoni* n. sp.

**Funding**

This study and field work of one of us (I.I. Marchenko) was supported by The Federal Fundamental Scientific Research Programme for 2013–2020 [VI.51.1.7. 30.4].

**References**

Athias-Henriot C. 1973. Observations sur les genres *Neojordensia* Evans et *Orthadenella* n. g. en Europe occidentale (Gamasides, Dermanyssina, Ascidae). Acarologia. 15:18–32.

Bregetova NG. 1977. Fem. Aceosejidae Baker et Wharton, 1952 (sensu Evans, 1958). In: Ghilyarov MS, Bregetova NG, editors. Key to the soil inhabiting mites. Mesostigmata. Leningrad: Nauka; p. 169–226. Russian.
Christian A, Karg W. 2006. The predatory mite genus Lasioseius Berlese, 1916 (Acari, Gamasina). *Abhandlungen und Berichte des Naturkundemuseums* Görlitz. 77:99–250.

De Leon D. 1963. A new genus and twelve new species of mites from Mexico and Southeast United States (Acari: Blattisocidae). *Fla Entomol.* 46:197–207. doi:10.2307/3493632

Evans GO. 1958. A revision of the British Aceosejinae (Acarina: Mesostigmata). *Proc Zool Soc Lond.* 131:177–229. doi:10.1111/j.1096-3642.1958.tb00685.x

Evans GO. 1963. Observations on the chaetotaxy of the legs in the free-living Gamasina (Acarina: Mesostigmata). *Bull Br Mus (Nat Hist), Zool Ser.* 10:275–303.

Gwiazdowicz DJ. 2007. Ascid mites (Acari, Mesostigmata) from selected forest ecosystems and microhabitats in Poland. Poznań: Wydawnictwo Akademii Rolniczej.

Johnston DE, Moraza ML. 1991. The idiosomal adenotaxy and poroidotaxy of Zerconidae (Mesostigmata, Zerconina). In: Dusbábek F, Bukva V, editors. *Modern acarology*. Vol. 2. The Hague: SPB Academic Publishing; p. 349–356.

Karg W. 1993. Acari (Acarina), Milben Parasitiformes (Anactinochaeta), Cohors Gamasina Leach. Raubmilben. Die Tierwelt Deutschlands. 59:1–523.

Lindquist EE. 1994. Some observations on the chaetotaxy of the caudal body region of Gamasine mites (Acar: Mesostigmata), with a modified notation for some ventrolateral body setae. *Acarologia.* 35:323–326.

Lindquist EE, Evans GO. 1965. Taxonomic concepts in the Ascidiae, with a modified setal nomenclature for the idiosoma of the Gamasina (Acarina: Mesostigmata). *Mem Entomol Soc Can.* 47:1–64.

Lindquist EE, Krantz GW, Walter DE. 2009. Order mesostigmata. In: Krantz GW, Walter DE, editors. *A manual of acarology*. 3rd ed. Lubbock: Texas Tech University Press; p. 124–232.

Lindquist EE, Moraza ML. 2010. Revised diagnosis of the family Blattisocidae (Acar: Mesostigmata: Phytoseioidea), with a key to its genera and description of a new fungus-inhabiting genus from Costa Rica. *Zootaxa.* 2479:1–21.

McGraw JR, Farrior MH. 1969. Mites of the superfamily Parasitoidea (Acarina: Mesostigmata) associated with Dendroctonus and Ips (Coleoptera: Scolytidae). *N C Agric Exper Stat Tech Bull.* 192:1–162.

Moraza ML, Lindquist EE. 2011. A new genus of fungus-inhabiting blattisociid mites (Acar: Mesostigmata: Phytoseioidea) from Middle America, with a key to genera and subgenera of the subfamily Blattisocinae. *Zootaxa.* 2758:1–25.