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Rediscovery and redescription of the type species of *Myrmozercon*, *Myrmozercon brevipes* Berlese, 1902 (Acari: Mesostigmata: Laelapidae)

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ABSTRACT — The type species of *Myrmozercon* (Mesostigmata: Laelapidae), *M. brevipes* Berlese, 1902, previously known only from its type collection from *Tapinoma erraticum* Latreille (Hymenoptera: Formicidae), is rediscovered after more than 100 years. The species is redescribed from specimens collected from two nests of *T. erraticum* in western Greece, providing new insights into this unusual species, which represents the most highly modified member of its genus. This species is unique in *Myrmozercon* in having its first pair of legs much shorter than legs II-IV, highly specialised chelicerae that probably lack a fixed cheliceral digit and have a flange-like moveable digit, and the deutosternal rows each with a single denticle.

KEYWORDS — *Myrmozercon brevipes*; new occurrences; Greece; myrmecophilous mites

INTRODUCTION

The genus *Myrmozercon* Berlese, 1902 is one of the better known genera of mites from ant nests, being found in most regions of the world (Rosario and Hunter 1988; Walter 2003). Berlese (1902) provided the written description of the type species, *Myrmozercon brevipes*. The following year, Berlese (1903) described three closely related species in the genus *Myrmonyssus*, distinguished by lacking the highly hypertrichous dorsal shield found in *M. brevipes.* Berlese (1904) added a further species of *Myrmonyssus* and also illustrated *M. brevipes* and all four species of *Myrmonyssus*.

Nine species were gradually added to *Myrmonyssus* (Banks 1916; Berlese 1916; Hull 1923; Vitzthum 1930; Sellnick 1941; Baker and Strandtmann 1948; Hunter and Hunter 1963). However no further species were added until Rosario and Hunter (1988) described another two species, and more importantly synonymised the *Myrmonyssus* under *Myrmozercon* because the characters used to define each genus (form of the ventral shields and hypertrichy of the dorsum) were shared by species placed in either genus.

More recently, Shaw and Seeman (2009) synonymised the monotypic genus *Parabisternalis* Ueckermann and Loots, 2011 with *Myrmozercon*, and established that *Laelaps flexuosa* Michael, 1891 should also be considered a *Myrmozercon.* In the past few years the genus has expanded to comprise 25 species (Shaw and Seeman 2009; Joharchi

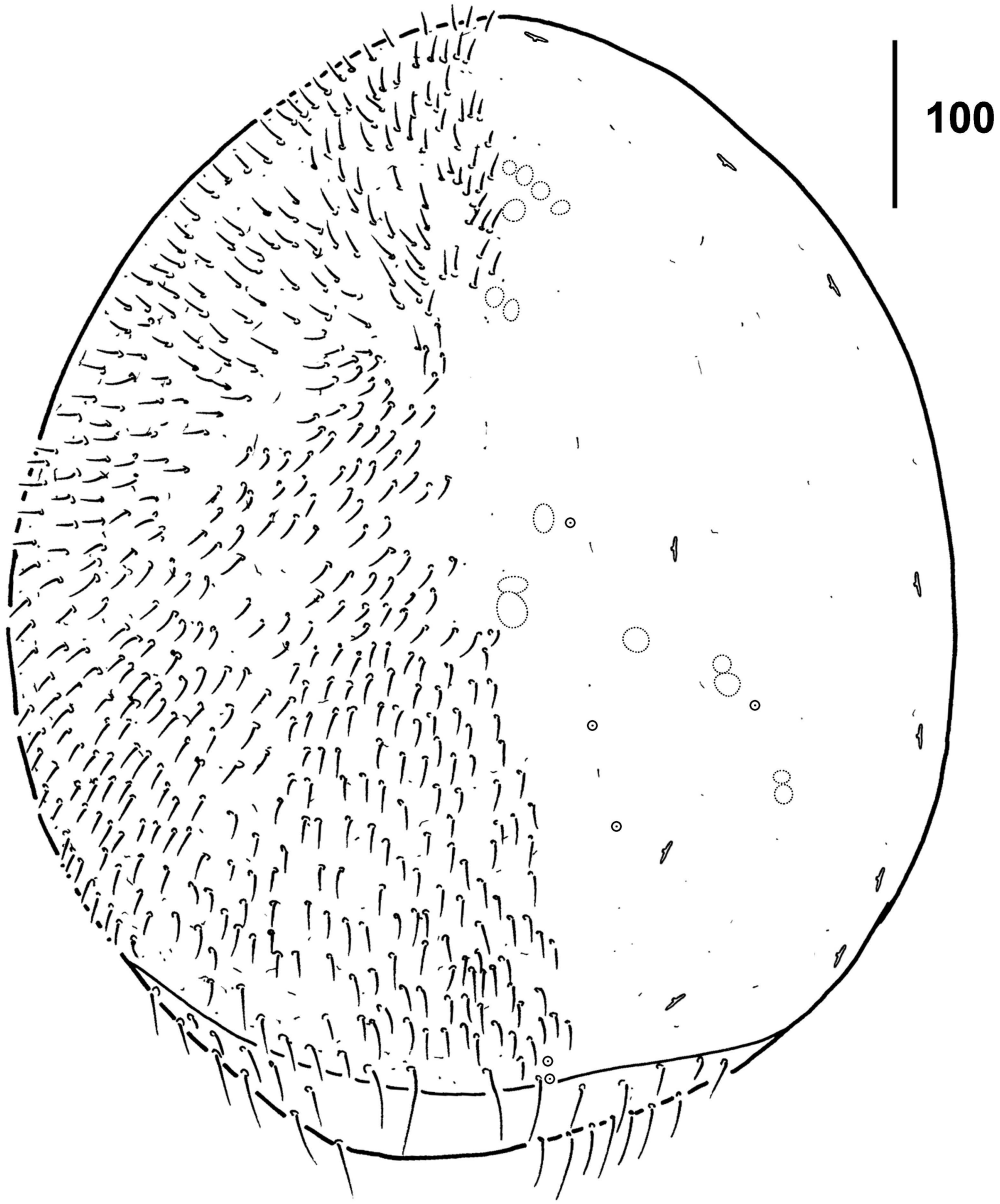


FIGURE 1: *Myrmozercon brevipes* Berlese 1902, female: Dorsal shield. Lyrifissures, pores and sigillae are shown on the right-hand side.

et al. 2011; Trach and Khaustov 2011; Ghafarian *et al.* 2013; Joharchi and Moradi 2013; Babaeian *et al.* 2013).

During recent field work in Greece, several specimens of the type species *M. brevipes* were found. This collection was the first since its description, and the species has not been redescribed until now.

Materials and methods

Specimens were collected during an expedition to Greece by the Hungarian Natural History Museum and the Systematic Zoology Research Group of the Hungarian Academy of Sciences. Some specimens were cleared in lactic acid and mounted in glycerol for examination; these specimens are stored in 75% ethanol. The remaining specimens were cleared in Nesbitt's solution and slide-mounted in Hoyer's medium. Mite specimens were examined with a light microscope (ODS: Nikon Eclipse 80i with DIC); drawings were made with the aid of a drawing tube. Scanning micrographs were taken in the Hungarian Natural History Museum with a HITACHI SN 2600 scanning electron microscope; the specimens investigated were sputter-coated with gold-palladium. The specimens are deposited in the Soil Zoology Collections of the Hungarian Natural History Museum (HNHM) and Queensland Museum, South Brisbane, Australia (QM). Leg and idiosomal chaetotaxy follows Evans (1963) and Evans and Till (1965) as adapted from Lindquist and Evans (1965). Width of the idiosoma was taken at the level of coxae IV; its length along the midline. Measurements in the description and scale bars are in micrometres.

Results

Myrmozercon Berlese, 1902

Diagnosis — As of Shaw and Seeman (2009), with amendment by Joharchi and Moradi (2013) based on *Myrmozercon michaeli* Joharchi, 2013 (seven rows of deutosternal denticles instead of > 7) and the following modification based on the redescription of the type species: fixed digit of chelicerae reduced to absent; deutosternal groove with 5-16 rows of numerous denticles, or each row comprising one large denticle.

Myrmozercon brevipes Berlese, 1902

Myrmozercon brevipes Berlese 1902: p. 700.
Myrmozercon brevipes: Berlese 1904: p. 313 (female chelicera), p. 314 (male chelicera), p. 445 (redescription). Table 19, Figs. 169-172.

Material examined — Four females and one male (HNHM). Greece, Aetolia-Acarnania peripheral unit, Akarnanika Mts, Trifos, small artificial pond and its shore vegetation S of the village, 38°48.396′ N, 21°05.650′ E, 330 m, 6 May 2011, nest of *Tapinoma erraticum* Latreille, coll. J. Kontschán, D. Murányi, T. Szederjesi and Zs. Ujvári.

Five females, one male (HNHM) and three females (QM). Greece, Ionian Islands, Lefkada peripheral unit, Rahi, 38°43.363 N, 20°41.404 E, 50 m, 06 May 2011, nest of *T. erraticum*, coll. J. Kontschán, D. Murányi, T. Szederjesi and Zs. Ujvári.

Diagnosis (based on female) — Dorsal shield densely hypertrichous, setal length 20 – 40; posterior margin of shield rounded, not truncated; soft cuticle posterior to shield hypertrichous. Sternal shield horseshoe-shaped (inverted U-shape); setae *st4* present; epigynal shield sculpturing lineate-reticulate, shield bearing setae *st5* only; one pair of metapodal shields present; anal shield peltate. Palp setal count (trochanter to tibia) 1-5-5-11; subcapitular groove with 8 rows of denticles, with one large denticle per row; palp coxal seta absent. Chelicerae highly modified, terminating in small membranous flange; fixed digit absent. All legs short, leg I distinctly shorter (280 – 295) than all other legs (leg II 370 – 410; leg III 385 – 425; leg IV 410 – 445); setal counts (coxa to tibia) for legs I-IV: 2-4-8-8-8, 2-4-8-8-7, 2-5-6-10-9, 2-5-8-8-7; all leg setae simple.

Description — *Female* (Figs. 1-6; n = 12).

Dorsal idiosoma (Figs. 1, 2A) — Dorsal shield length 640 – 760, width 550 – 640, subcircular, cuticle smooth, with several hundred fine setae, length 20 – 40. Most marginal setae short; dorsal marginal setae become longer posteriorly (longest 50 – 75) on shield and soft cuticle. Dorsal shield with 16 pairs of

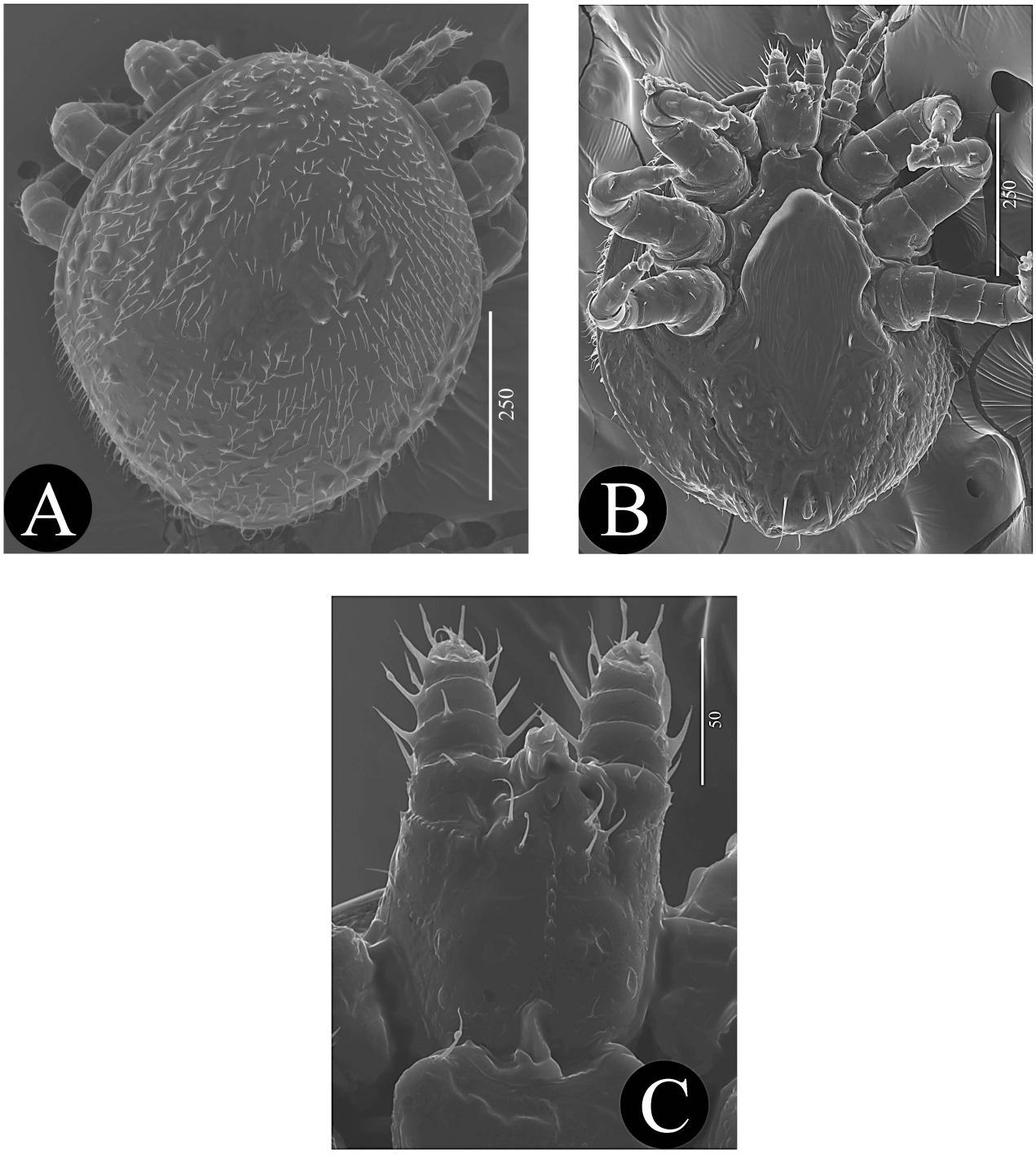


FIGURE 2: Scanning electron micrographs of *Myrmozercon brevipes* Berlese 1902, female: A – Dorsum; B – Venter; C – Ventral gnathosoma.

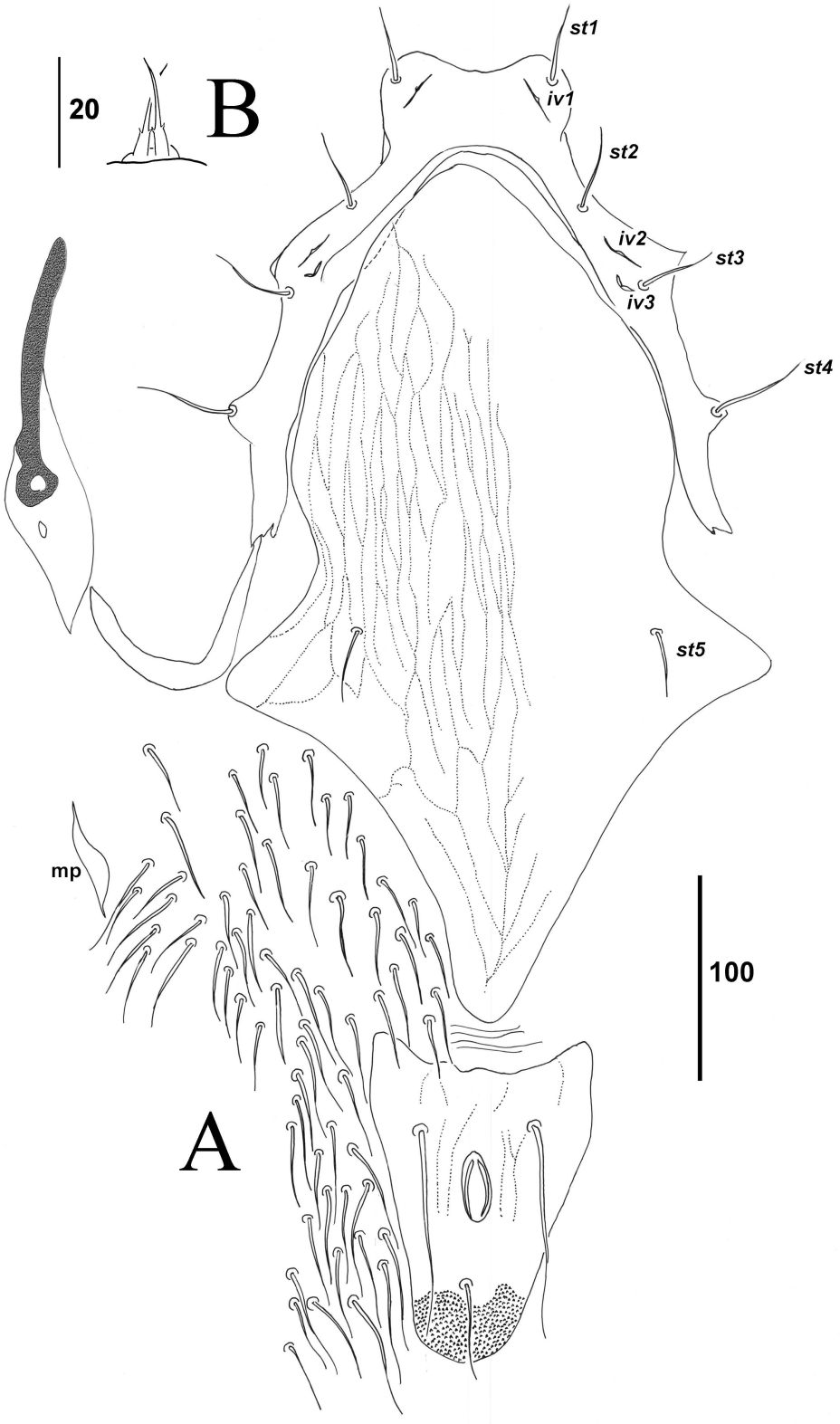


FIGURE 3: *Myrmozercon brevipes* Berlese 1902, female: A – Venter; extensive setation of opisthogaster partially illustrated (mp = metapodal platelet); B – Tritosternum.

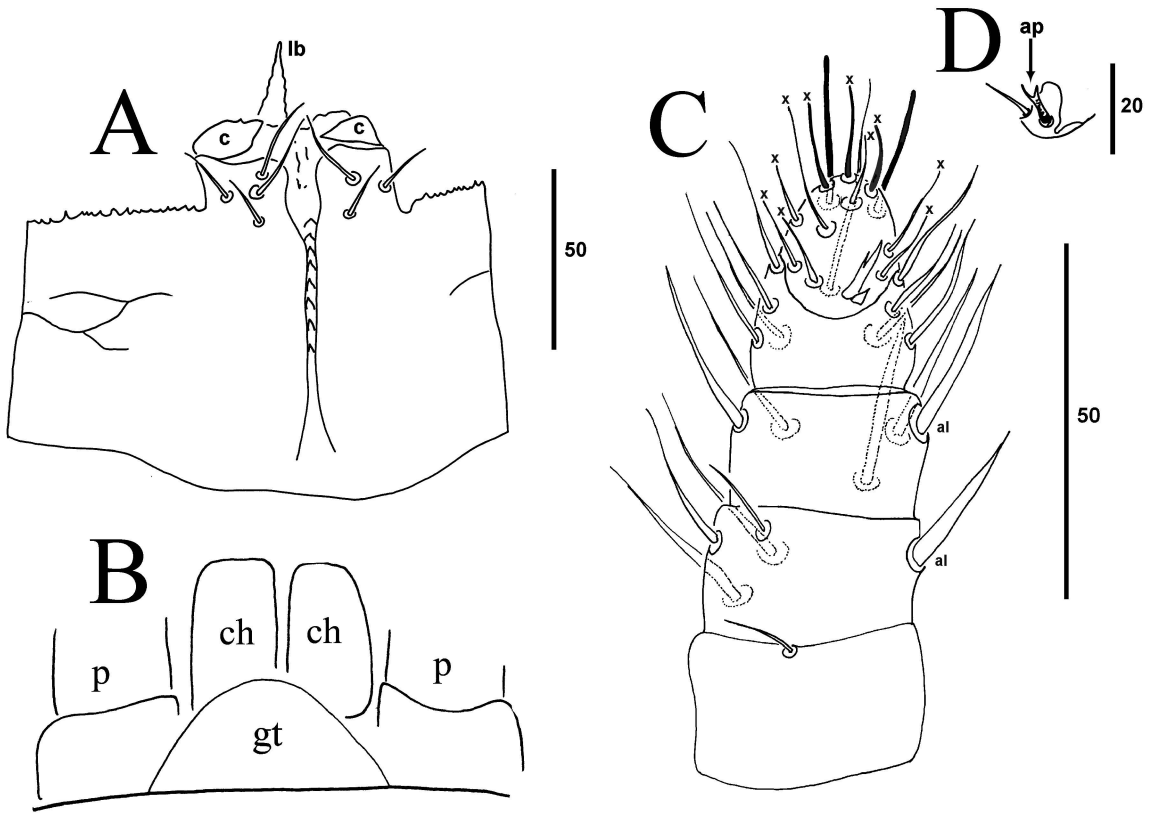


FIGURE 4: *Myrmozercon brevipes* Berlese 1902, female: A – Subcapitulum (c = corniculus; lb = labrum); B – Gnathotectum (ch = chelicera; gt = gnathotectum; p = palp); C – Palp (x = tarsal seta; blunt-tipped sensory setae are coloured black); D – Detail of palp apotele (ap) (different specimen).

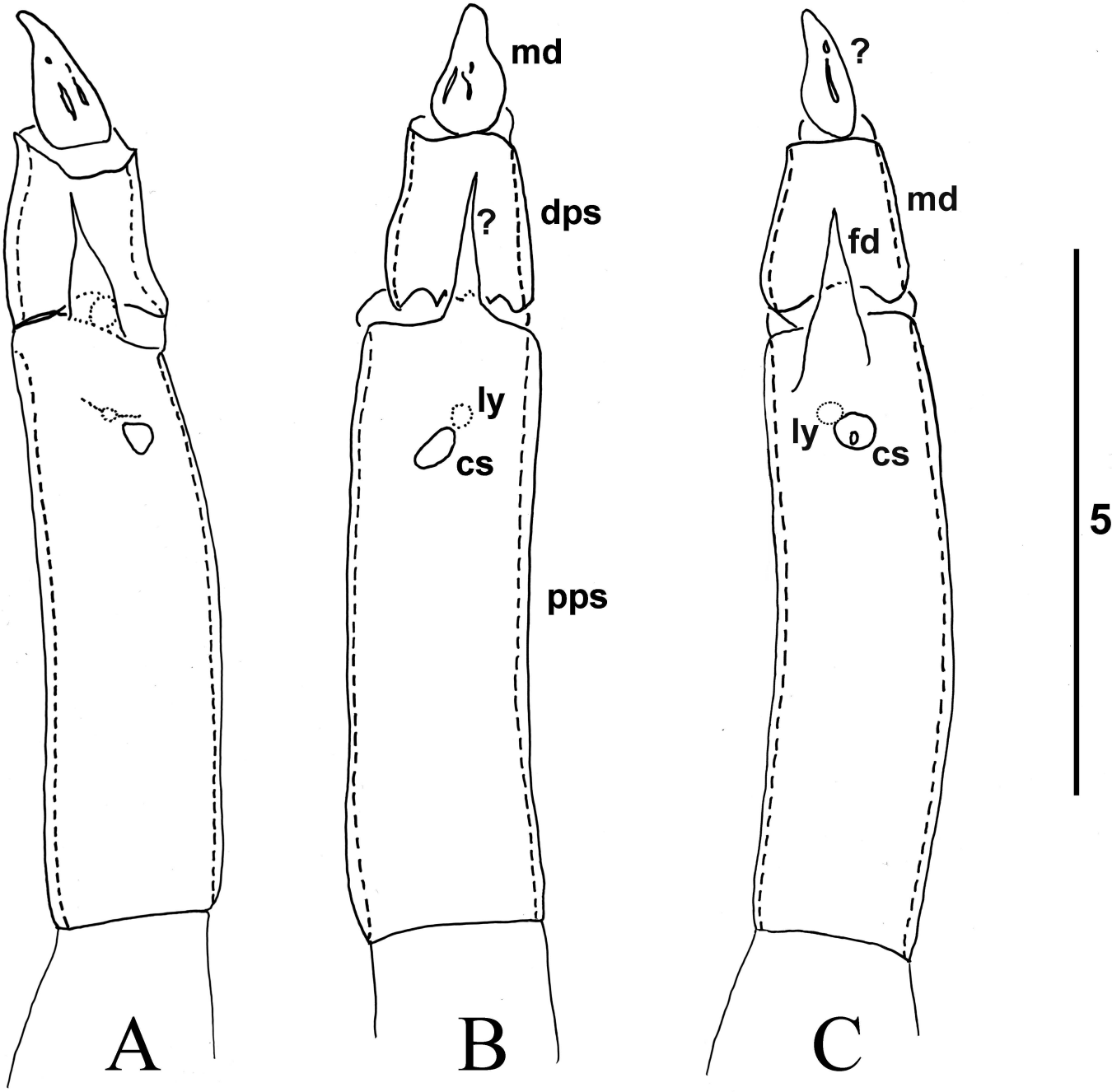


FIGURE 5: *Myrmozercon brevipes* Berlese 1902, female, chelicerae from three different specimens, with two interpretations of cheliceral morphology labelled (see Remarks). cs = vestigial cheliceral seta; dps = distal pseudosegment of second cheliceral digit; ly = lyrifissure; md = movable digit; pps = proximal pseudosegment of second cheliceral digit; ? = novel structure.

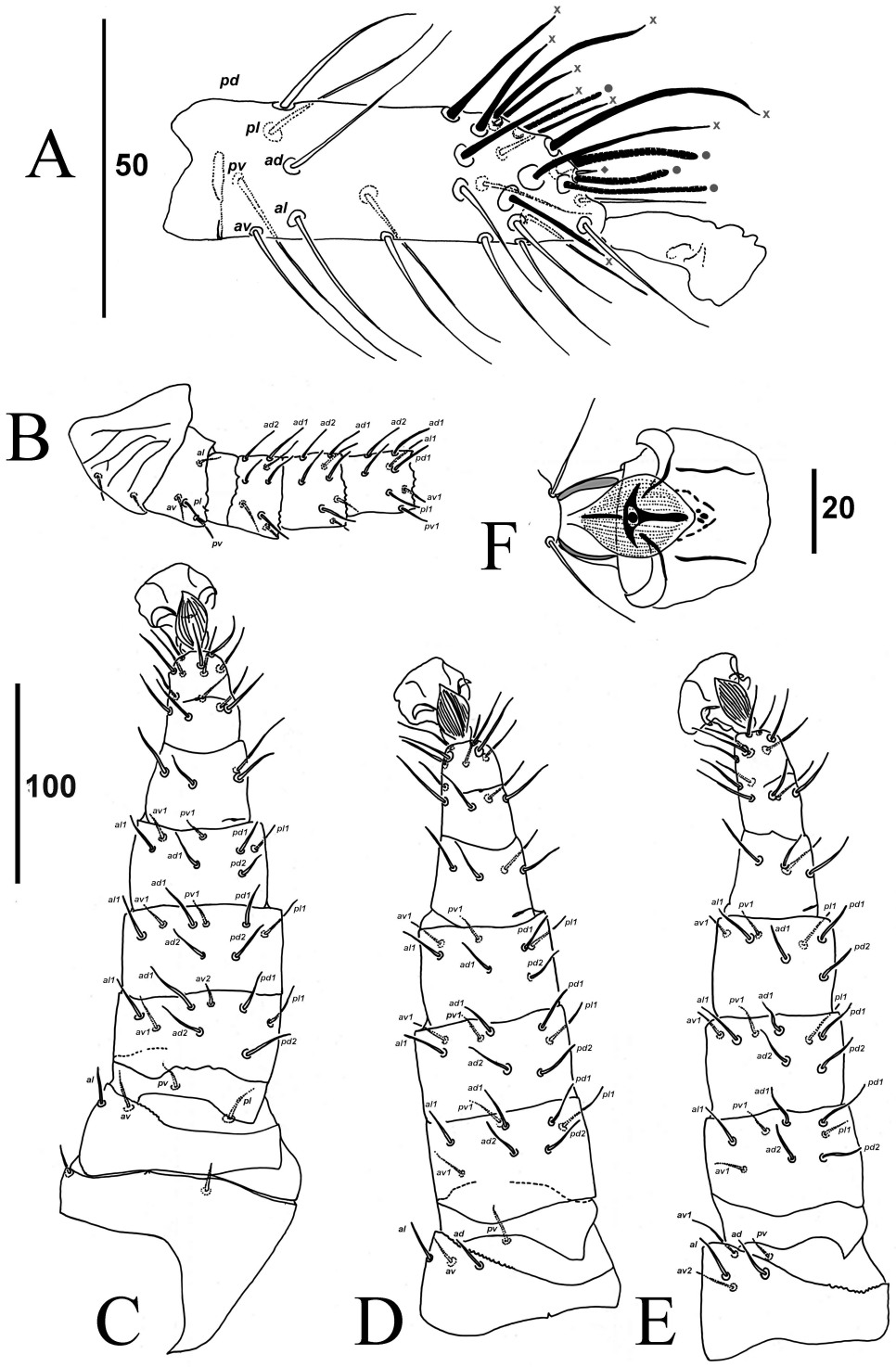


FIGURE 6: *Myrmozercon brevipes* Berlese 1902, female: A – Tarsus I (circle = blunt-tipped, ribbed seta; diamond = minute seta; x = abruptly tapering seta); B – Leg I, coxa to tibia; C – Leg II, coxa to tarsus; D – Leg III, trochanter to tarsus; E – Leg IV, trochanter to tarsus; F – Ambulacrum III.

visible pore-like structures (ten slit-like lyrifissures; all others rounded, surrounded by lacunae). Sigillae small arranged in medial groups on podontal region; groups on opisthonotal region more lateral.

Ventral idiosoma (Figs. 2B, 3A) — Tritosternum (Fig. 3B) with short laciniae, length 40 – 45, unfused, laciniae each with a pair of tiny spines 14 – 16 from base, base hyaline, evanescent. Presternal area membranous, presternal shields absent. Sternal shield narrow, highly concave, horse-shoe shaped, medial length 30 – 34, maximum length 240 – 260, length to seta *st4* 160 – 185, width at level of setae *st2* 125 – 140, width at level of *st4* 250 – 270, ratio medial length / length to st4 0.2; sternal shield smooth, bearing smooth slender setae *st1-4* (39, 35 – 37, 38 – 39, 43 – 45, respectively) and lyrifissures *iv1-3*. Endopodal shields absent, or reduced and fused to exopodal shield around posterior margin of coxa IV. Epigynal shield (full length 410 – 420; 180 – 195 from *st5* to posterior tip) with well-defined broadly rounded anterior margin, with longitudinal reticulation, pointed posteriorly, maximum width 265 – 270; setae *st5* 30 – 35; lyrifissures *iv5* not present on shield (nor detected in soft cuticle). Metapodal platelets elongate, weakly formed (55 – 63 × 12 – 14). Peritremal shield small, smooth, free posteriorly and surrounding only posterior half of peritreme, not fused to dorsal shield, bearing one gland pore; peritreme extending to level of anterior coxa III. Anal shield peltate (length 150 – 170 × width 105 – 110), shield with few longitudinal reticulations, with post-anal seta (36 – 37) shorter than para-anal setae (100 – 105); cribrum a dense field of spicules extending from just behind post-anal seta to posterior margin; sigillae absent. Soft cuticle hypertrichous, with 350 – 400 setae, setal length 30 – 45.

Gnathosoma (Figs. 2C, 4) — Gnathotectum (Fig. 4B) with anterior margin smooth, rounded. Subcapitulum (Fig. 4A) with eight deutosternal rows each comprising a single denticle; corniculi (21 – 24) hyaline, adpressed to anterior margin of subcapitulum, tips acuminate directed medially; subcapitulum not extending medially beyond corniculi; internal malae not detectable or perhaps absent; labrum (16 – 30), reduced, extending to level of anterior margin of palp trochanter to mid-femur; hypostomal setae fine, *h1* longer (27) than outer posterior setae *h2* (15), inner posterior setae *h3* (16); illustrated specimen with duplication of seta *h1* on right-hand side, scanning electron micrographed specimen lacking seta *h2* on right-hand side (Fig. 2C); palpcoxal setae absent; setae *h2* 40 – 42 apart. *Palps* (Figs. 4C-D): length 92 – 94 with simple setae except lateral setae on palp femur and genu thickened, dorsal setae on palp femur, genu and tibia thickened; femur without dorsal anterolateral spine; tarsus placed entirely ventrally; setation of palp segments from trochanter to tarsus: 1-5-5-11-10, tibia with two apical round-tipped hollow tibial setae on small tubercles, three tarsal setae of similar form; palp tarsal claw two-tined, with tines tapered, claw flanked by small cusp, ventral tine shorter (2 – 3 from fork) than dorsal tine (6 from fork, 10 – 11 from base).

Chelicerae (Figs. 5A-C) — Second cheliceral segment seemingly split into two segments (see Remarks); proximal pseudosegment segment 52 – 55, bearing vestigial cheliceral seta and lyrifissure, and distal membranous process; distal pseudosegment 17 – 19; movable digit (12) a hyaline lobe bearing some narrow, straight sclerotised elements; arthrodial corona and fixed digit absent.

Legs (Figs. 6A-F) — Excluding ambulacra, lengths of leg I 280 – 295, leg II 370 – 410, leg III 385 – 425, leg IV 410 – 445. Tarsus I (72 – 77) with elongate ambulacrum (20 – 24), without claws; ambulacra II-IV (48 – 55), each with a dorsal ribbed leaf-like pretarsus (Fig. 6F); claws I absent, II-IV hyaline. Setation of leg segments I-IV: coxae 2-2-2-2; trochanters 4-4-4-5 (TrI-III with larval complement for Laelapidae); femora 8-8-8-8 or, as (*al-ad/av*, *pd/pv*, *pl*), I-IV (1-2/1, 2/1-1); genua 8-8-8-8, or I-IV (1-2/1, 2/1-1); tibiae 8-7-7-7, or I (1-2/1, 2/1-1), II-IV (1-1/1, 2/1-1); tarsi II-IV 17-17-17, with *ad1-pd1* seta-like, apical processes 0.4-0.5 × length of pretarsi, *ad1* subequal to *pd1*. Tarsus I with 30 setae: four ribbed blunt-tipped setae (length 16 – 26) dorsodistally among dorsodistal cluster of nine abruptly tapering setae plus one tiny seta (3), and 16 proximal and ventral strongly tapered setae. All setae on other leg segments unspecialised, smooth, length 13 – 35.

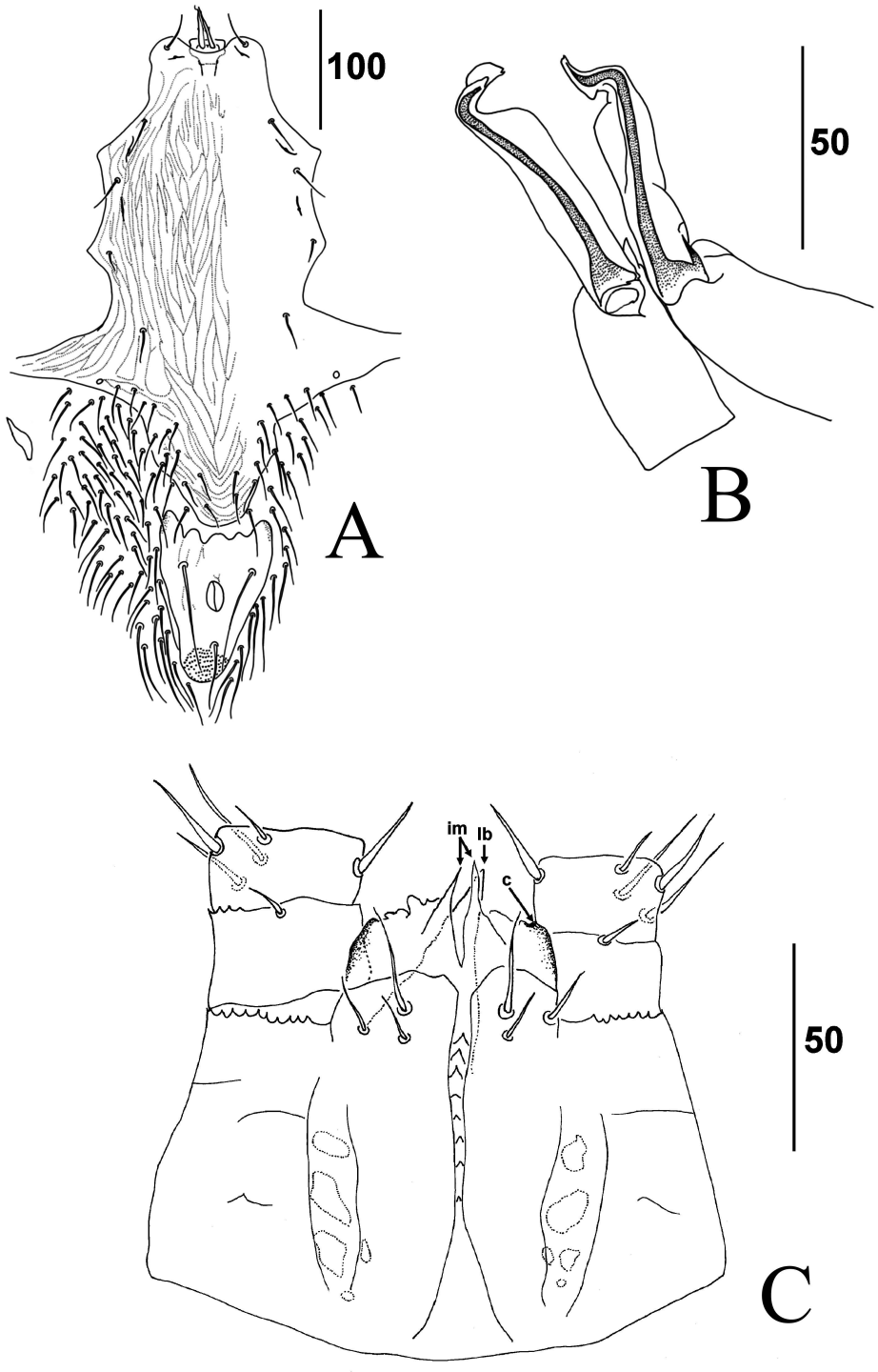


FIGURE 7: *Myrmozercon brevipes* Berlese 1902, male: A – Venter; extensive setation of opisthogaster partially illustrated; B – Chelicerae; C – Ventral gnathosoma (c = corniculus; im = internal malae; lb = labrum).

Male (Figs. 7).

Dorsal idiosoma — Dorsal shield (length 650 – 660 × width 550 – 560), similar in ornamentation and setation to female.

Ventral idiosoma (Fig. 7A) — Sternoventral shield (420 long × 200 wide at level of *st4*), fused to exopodal shield, bearing slender sternal setae and 21 opisthogastric setae at posterior margin; of setae *st1-5*, *st5* longest (36), other sternal setae (30 – 32); longitudinal reticulation throughout except near anterolateral margin. Genital operculum in anterior concavity of sternal shield. Anal shield similar to female (length 135 × width 100). Soft cuticle hypertrichous, setal length 30 – 80, longer posteriorly. Poroids on soft cuticle and anal shield absent; lyrifissure *iv5* near posterolateral margin of sternoventral shield.

Gnathosoma (Figs. 7C) — Similar to female, setae *h1* 28, *h2* 14, *h3* 11, palpcoxal seta absent, palp length 95, corniculi similar to female. Subcapitulum extends medially as two finely spiculate processes reaching level of mid-palp femur; labrum finely spiculate, larger, thicker than in female, reaching level of mid-palp femur. *Chelicerae* (Fig. 7B): fixed digit absent; movable digit represented by hyaline sheath that encloses spermatodactyl (length 73).

Legs — Chaetotaxy as in female, legs subequal in length compared with female. Tarsus I as in female; all other leg setae unspecialised, as in female.

Remarks — The only previous record for *M. brevipes* is from Italy with the ant *T. erraticum* (Berlese 1904). Our new specimens are from Greece, but from the same host species, and we expect *M. brevipes* to be present throughout the intervening terrain in the Balkan Peninsula and central Europe where *T. erraticum* is known to occur.

Species of *Myrmozercon* are highly host specific, with no species known from more than one species of ant, although in three known cases two species of *Myrmozercon* are known to utilize the same species of ant (Shawand Seeman 2009). In these cases, the species pairs conform to a Hutchinsonian size ratio (Shawand Seeman 2009). Therefore, the host species and size of the mite is informative. Our specimens match Berlese's (1904) illustrations in all regards, including the bizarre chelicerae of the female and male. Their size is also similar. Berlese (1902) measured the female as 800 μm × 609 μm and the male at 700 μm × 560 μm. Dr Roberto Nannelli (Berlese Collection, Florence) measured all available intact females, including the holotype (n = 4, on slides 5/39 and 5/40, holotype measurement first followed by range of values based on three other females at the Berlese Collection), and recorded the length as 792 μm (720-768) and width as 600 μm (552 – 576). Berlese's male was remeasured at 720 μm × 552 μm. Our females (640 – 760 μm × 550 – 640 μm) and males (650 – 660 μm × 550 – 560 μm) tended to be slightly shorter, and Berlese (1904) also illustrated the species with a slightly tapering idiosoma, while ours are ovate. We regard our specimens as the same species, attributing the small differences in size and shape to intraspecific variation.

The chelicerae of *M. brevipes* are unlike any other member of the genus (or perhaps the Acari) and are difficult to interpret. Two hypotheses are given. In the first, the lateral cheliceral lyrifissure has enlarged to such a size that it separates the second cheliceral segment into two pseudosegments (Fig. 5B). The dorsal lyrifissure and vestigial cheliceral seta remain on the proximal pseudosegment, while the distal pseudosegment terminates in a membranous movable digit that includes small rod-like sclerotised elements. The dorsal, membranous flange at the margin of the pseudosegmental division is a novel structure. The lyrifissures and setae are absent or not visible in males. The terminology in the description is based on this hypothesis.

An alternative interpretation is that the movable digit is equivalent to the distal pseudosegment of the first hypothesis, and this bears a novel structure distally (Fig. 5C). In support of this is Berlese's (1904) drawing of cheliceral musculature for *M. brevipes*, showing the adductor muscle of the movable digit attaching to the first separation in the second cheliceral digit. In this interpretation, the small membranous flange is a much reduced fixed digit. Cheliceral musculature was poorly visible in our specimens, but what was visible supported Berlese's drawing.

Discussion

Ghafarian *et al.* (2013) suspected that the species *Myrmozercon ovatum* Karawajew (1909) was a synonym of *M. brevipes*, an opinion we concur with, but we also could not locate the type specimens of *M. ovatum* in Kiev, where the myrmecologist Karawajew (also spelled Karavaiev or Karawaiew) was based in 1909. *Myrmozercon ovatum* matches the few comparable characters in the original description, most notably the much reduced legs I, and comes from the same host species and is the same size as *M. brevipes*.

Joharchi *et al.* (2011) discussed character variation in *Myrmozercon*, noting instability in character states within the genus, such as hypertrichy of the dorsal shield, hypo- or hypertrichy of leg coxae, hypotrichy of palp coxae, hypotrichy of other leg segments, and reduction of sternal shields and their setation. *Myrmozercon brevipes* is a remarkably specialised member of the genus, presumably explaining why Berlese erected the genus *Myrmonyssus* for all subsequent species he described. Some of its unusual or reductionist characters do occur in other species, such as the highly hypertrichous dorsum, legs with scarcely more setae than those found in a laelapid larva, and a highly reduced horseshoe-shaped sternal shield. However, the form of the chelicerae, tiny legs I and the deutosternum reduced to single denticles are unique.

Myrmozercon brevipes and its likely synonym, *M. ovatum*, are also probably unique in the extreme reduction of legs I. In other *Myrmozercon* species where species are described in sufficient detail, legs I are the longest or subequal in length compared to legs II-IV. However, *M. brevipes* has extremely short (ca. 2/3 length of leg II) and slender legs I, unlike any other *Myrmozercon* (note: leg size of *Myrmozercon titan* Berlese (1916) was not reported, but its first pair of legs are very long [R. Nannelli, pers. comm.]).

In summary, *Myrmozercon brevipes* – the type species of *Myrmozercon* – is a highly specialised representative of its genus, so much so that it begs the question whether *Myrmonyssus* should be reinstated. However, the closest relatives of *M. brevipes* seem to be other *Myrmozercon* species, so it is likely that *M. brevipes* has arisen within the genus *Myrmozercon*, and that further investigations should uncover similarly specialised species.

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