Persian J. Acarol., 2023, Vol. 12, No. 2, pp. 199–209.
https://doi.org/10.22073/pja.v12i2.79934
Journal homepage: http://www.biotaxa.org/pja

http://zoobank.org/urn:lsid:zoobank.org:pub:30B7CADA-7557-4147-BCFA-42444630A7DB

Article

Rediscovery of *Myrmozercon brachiatus* Berlese (Acari: Mesostigmata) in south-west Iran

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ABSTRACT
Myrmozercon brachiatus Berlese, 1903 (Mesostigmata: Laelapidae), originally described from Portici, Naples, Italy in 1903, is rediscovered for the first time in Iran from nests of *Messor mediosanguineus* Donisthorpe, using comparison with photographs of its holotype. These two female specimens were collected at Ben region, Chaharmahal va Bakhtiari Province, Iran. This new finding, far from the type locality, suggests a larger distribution of the species in the Palaearctic. A morphological description of these two specimens is provided.

KEYWORDS: Iran, Laelapidae, myrmecophilous mites, redescription, taxonomy.

PAPER INFO.: Received: 28 December 2022, Accepted: 24 February 2022, Published: 15 April 2023

INTRODUCTION

Ants (Hymenoptera: Formicidae) form complex colonies, harboring resources that can potentially be exploited by myrmecophiles (organisms living in association with ants) (Laakso and Setälä 1998). Through the construction of their nest, the inhabitants alter the condition of the nesting substrate. The humidity, texture, chemical composition, temperature, and amount of organic materials are drastically altered by the ants (Beattie and Culver 1983; Cole 1994; Boulton *et al.* 2003). This localized change in the soil (or other substrates) composition has been demonstrated to increase litter decomposition by mites and other microorganisms within the nest (Paris 2008), as well as to increase the overall abundance and biomass of these associated organisms (Beattie and Culver 1983; Wagner *et al.* 1997; Boulton *et al.* 2003). Harvester ants (*Messor* spp.) increase seed dispersal and protection and provide nutrients that increase seedling survivorship of the desert plants (Tevis 1958; O'Dowd and Hay 1980; Rissing 1986; Steinberger *et al.* 1991). Their nests have conspicuous crater entrances which are surrounded by chaff (refuse) piles (Wheeler and Rissing 1975). In addition, mites often attach to larger arthropods for dispersal. Through this primarily commensal relationship, mites can exploit scattered habitats more successfully than they would be able to do without external assistance (OConnor 1982; Hunter and Rosario 1988).

How to cite: Khalili-Moghadam, A. & Babaeian, E. (2023) Rediscovery of *Myrmozercon brachiatus* Berlese (Acari: Mesostigmata) in south-west Iran. *Persian Journal of Acarology*, 12(2): 199–209.

As many as 13 genera of laelapid mites (*Apolaelaps* Silvestri, 1911; *Cosmolaelaps* Berlese, 1903; *Euandrolaelaps* Bregetova, 1977; *Gaeolaelaps* Evans & Till, 1966; *Gymnolaelaps* Berlese, 1916; *Holostaspis* Kolenati, 1858; *Hypoaspisella* Bernhard, 1962; *Laelaspis* Berlese, 1903; *Myrmozercon* Berlese, 1902; *Neoberlesia* Berlese, 1892; *Pogonolaelaps* Nemati & Gwiazdowicz, 2016; *Reticulolaelaps* Costa, 1968; *Sphaeroseius* Berlese, 1904) are at least sometimes associated with ants (De Moraes *et al*. 2022). The genus *Myrmozercon* includes 27 species. According to the type locality and habitat, they are usually found in association with ants and known from Africa (three species), America (five species), Asia (eight species), Australia (five species), and Europe (six species) (De Moraes *et al.* 2022). So far, seven species of *Myrmozercon* have been reported from Iran (Kazemi and Rajaei 2013; Nemati *et al*. 2018). In this paper, *Myrmozercon brachiatus* is rediscovered and redescribed from nests of *Messor mediosanguineus* Donisthorpe, 1946 based on two female specimens.

MATERIALS AND METHODS

Mites were extracted from ant nest material using Berlese funnels, placed in lactic acid at 55 °C for clearing, and then mounted in Hoyer's medium on permanent microscope slides for examination. Line drawings were made using a drawing tube and figures were created with Corel X–draw software, based on the scanned line drawings. Measurements of structures are expressed as minimum-maximum ranges in micrometers (µm) which were obtained using a scaled ocular lens of an Olympus CX–31. The dorsal setae notation follows that of Lindquist and Evans (1965). Leg and palp setal notation and chaetotactic formulae are adapted from Evans (1963a, b). The length of the dorsal shield is the distance from its anteromedian edge anterior to bases of setae *j1* to its posteromedian edge posterior to bases of setae *Z5*; width of dorsal shield is measured at the widest part; length of the sternal shield is measured along the midline from anterior edge to its posterior margin (about slightly after *st3*), width measured between coxae II–III (widest point) and slightly above the insertion of *st2* (narrowest point); the length of genital shield is midline from the anterior margin to its posterior margin, and width was measured at widest point (middle of the wide part, above the insertion of *st5*) and middle of the narrow part (narrowest point). The length of anal shield is midline from the anterior margin to the posterior edge of the cribrum, and width was measured at the widest point. Setae were measured at the level of insertions to their tips and distance between setae as the distance between their insertions. Lengths of legs were measured dorsomedially, and tarsi were measured without the stalk and pretarsus. The terms lyrifissure and pore are used to refer to slit-shaped and circular or oval-shaped cuticular openings, respectively. We have attempted to identify all pore-like structures, but we acknowledge that some may have been overlooked.

RESULTS

Genus *Myrmozercon* Berlese

Myrmozercon Berlese, 1902: 699.
Myrmonyssus Berlese, 1903: 16. Type species *Myrmonyssus diplogenius* Berlese, 1903, designated by Berlese (1904) (synonymy by Rosario and Hunter 1988).
Myrmonyssus (*Laelaspulus*) Berlese (1904): 437. Type species *Myrmozercon acuminatus* Berlese, 1903, by original designation (synonymy by Shaw and Seeman 2009).
Parabisternalis Ueckermann & Loots, 1995: 35. Type species *Parabisternalis yemeni* Ueckermann & Loots, 1995, by original designation (synonymy by Shaw and Seeman 2009).
Type species: *Myrmozercon brevipes* Berlese,1902 by monotypy.
Type depository: Istituto Sperimentale per la Zoologia Agraria, Florence, Italy.

Type locality and habitat: Italy, Portici, Naples, on *Messor barbarus capitatus* var. *minor* [Animalia: Hymenoptera: Formicidae].

Diagnosis

The concept of *Myrmozercon* used here is based on that of Shaw and Seeman (2009) with modifications of Joharchi and Moradi (2013), and Kontschán and Seeman (2015).

***Myrmozercon brachiatus* (Berlese, 1903)**

Myrmonyssus brachiatus Berlese, 1903: 17.
Myrmonyssus brachiatus. Berlese 1904: 441; Vitzthum 1930: 89; Hunter and Hunter 1963: 335.
Myrmozercon brachiatus. Rosario and Hunter 1988: 470; Joharchi and Moradi 2013: 252; Joharchi *et al*. 2015: 558.

Materials examined

Specimens were collected from Chaharmahal va Bakhtiari Province, Ben county (Larak) (32° 35' 12" N, 50° 40' 22" E, 2406 m a.s.l.) from nest of *Messor mediosanguineus* Donisthorpe, 1946; coll. A. Khalili-Moghadam, 07 April 2022.

Specimen's deposition

Two females have been deposited in the Acarological Laboratory, Plant Protection Department, Agricultural College, Shahrekord University (APAS), Iran.

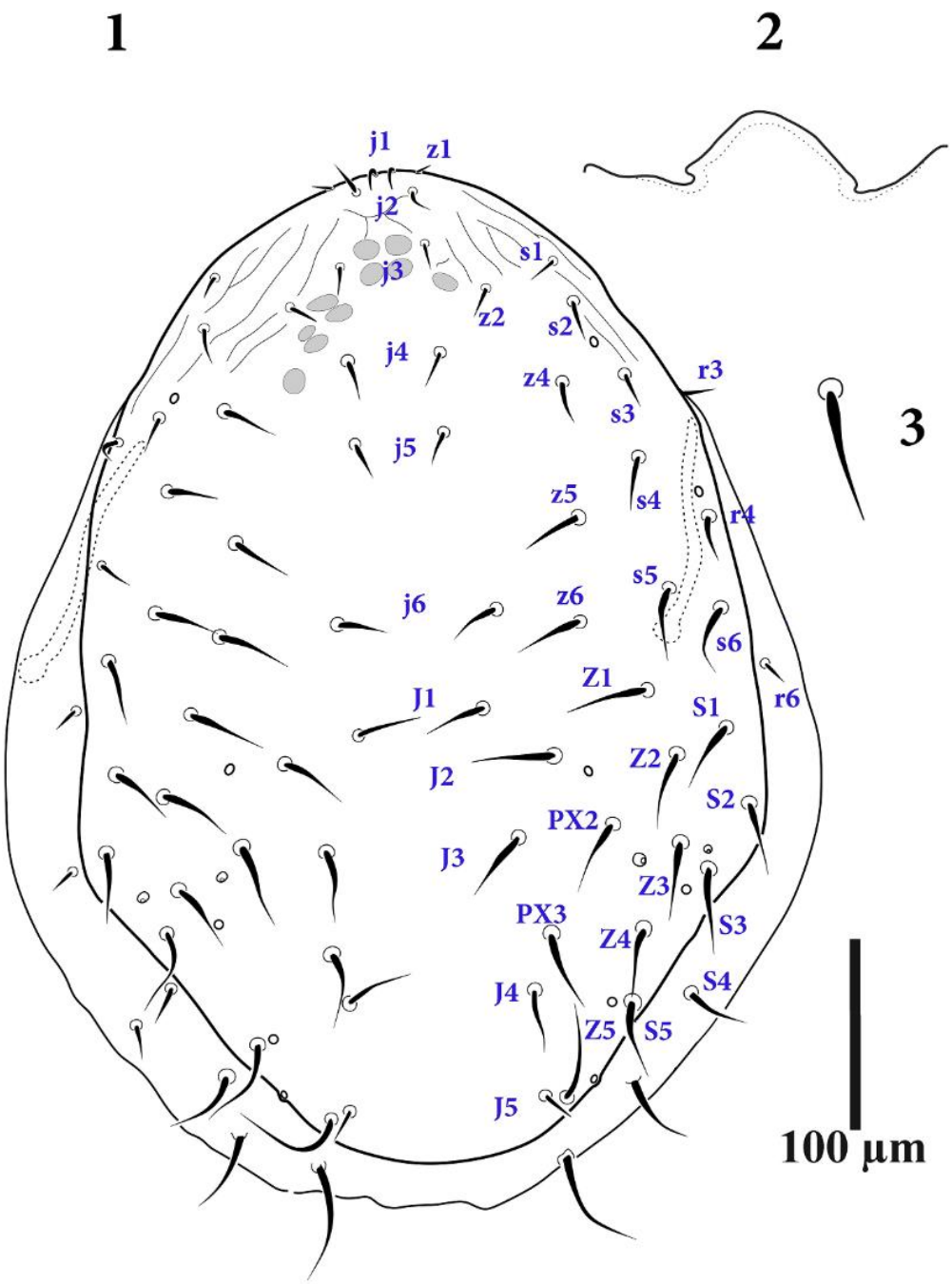
Diagnosis (female)

Dorsal shield ovoid-angulate and mostly smooth, with 36 pairs of smooth setae, five pairs of J-series setae (*J1-J5*); soft cuticle around and posterior margin of dorsal shield smooth (lacking striae); dorsal cuticle not hypertrichous; sternal shield with indistinct posterior margin, lateral margins slightly sclerotized; shape of genital shield distinctive (strongly constricted after insertion of setae *st5,* with two parts, first part wide, from anterior to slightly after st5 and second part narrow, from slightly after *st5* to posterior margin); metapodal plates absent; anal shield triangular; peritremes short, peritrematal shields and pores absent; opisthogastric soft integument with 10 pairs of smooth setae; moveable and fixed digit of chelicerae with two and one small teeth respectively, pilus dentilis and cheliceral seta absent; epistome smooth arc-shaped (edentate), corniculi short, irregularly formed; subcapitular groove with seven rows of denticles, with 7–9 denticles per row; palp coxal seta present, simple; tarsi with rudimentary claws and distinct pulvillus; leg I longer (390–434) than all other legs (leg II 285–320, leg III 222–275, leg IV 368–397); setal counts of legs I–IV (from coxa to tibia): 2-5-10-13-14; 2-5-10-11-10; 2-5-6-8-8; 1-5-6-7-9; genu IV with seven setae (*pl* absent).

Redescription (female)

Dorsal idiosoma (Figs. 1, 4) – Idiosoma 427–459 long and 300–336 wide; dorsal shield ovoid-angulate, 415–439 long, width at level of setae *S3*, 285–305, smooth medially, with uneven lineate-reticulate ornamentation on anterolateral areas, shield with 36 pairs of setae 19 pairs on podonotal area (*j1–6*; *z1–2*; *z4–6; s1–6*; *r3–4*) and 17 pairs on opisthonotal region (*J1–5*, *Z1–5*, *S1–5*), including *PX2* between *J3* and *Z3* and *PX3* between *J3* and *J4*, and *r6* located on ventral side opposite to coxae IV, and at about eight pairs of discernible pore-like structures, pores near the base of *j1* absent. Dorsal shield setae smooth, slightly thickened at the base (length 5–48) (Figs. 1, 3), opisthonotal setae longer than podonotal setae, *S5* and *Z5* longest and *z1* shortest. Lengths of podonotal setae: *j1* 17–20, *j2* 10–12, *j3* 7–10 shorter than other setae in series, *j4* 19–20, *j5* 17–20, *j6* 27–30; *z1* 5–7 shorter than other setae, *z2* 10–12, *z3* lacking, *z4* 22–24, *z5* 27–30, *z6* 32–34; *s1* 10–12, *s2-3* 14–17, *s4* 22–24, *s5* 34–

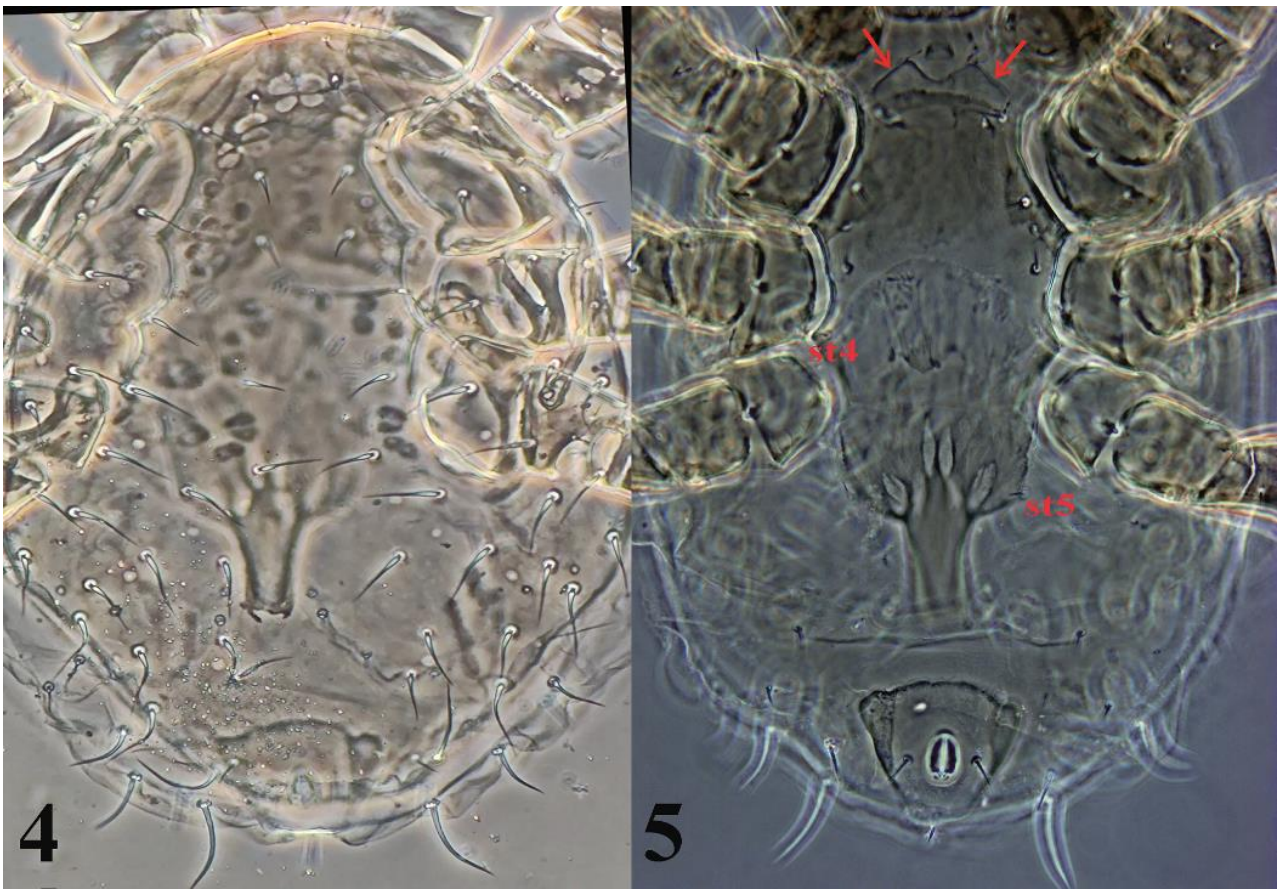
37, *s6* 34–37, *r3* 15–16, *r4* 17–20 and *r6* 11–13. Lengths of opisthonotal setae: *J1* 31–34, *J2-3* 34–37, *J4* 27–30, *J5* 12–15; *Z1*-2 34–37, *Z3* 32–34, *Z4* 34–37, *Z5* 46–48; *S1*-2 (34–37), *S3* (39–42), *S4* (31–34), *S5* (44–47), *PX2* (36–39), *PX3* (31–34).



Figures 1–3. *Myrmozercon brachiatus* (female) – 1. Dorsal idiosoma; 2. Epistome; 3. A dorsal seta.

Ventral idiosoma (Figs. 5–6) – Tritosternum with short columniform base (17–19) and pilose laciniae (53–56). Sternal shield sparsely lineate-reticulate on anterior, median surface smooth, 93–97 long (at level of slightly after *st3*), 120–127 wide (at level of projection between coxae II–III) and 78–82 between *st1* and *st2*, with a deep notch anteromedially at level of tritosternum placement; posterior margin unrecognizable. Sternal setae short and smooth, with tips not reaching bases of the

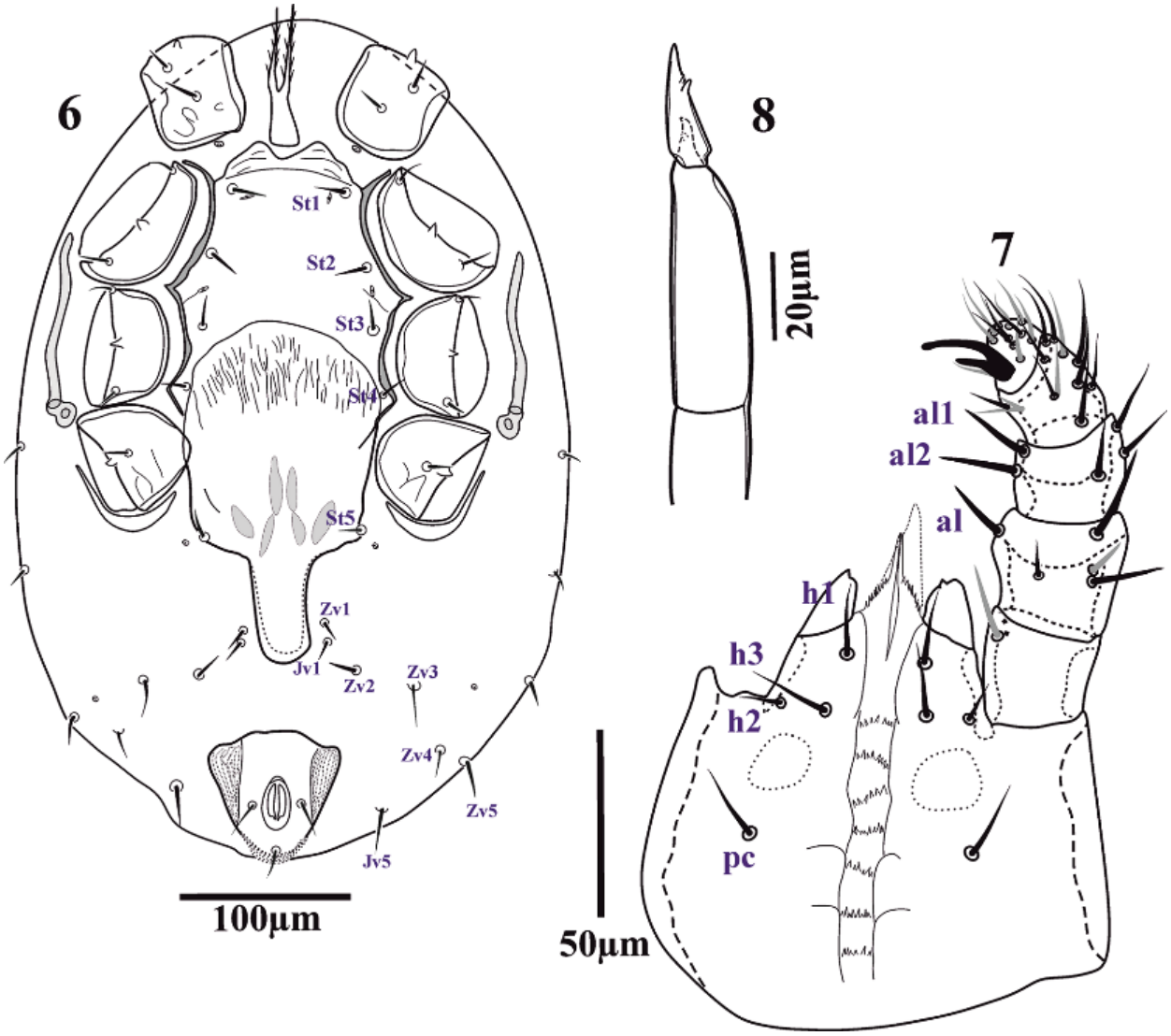
following ones, *st1* (19–22) and *st2-3* (14–17); lyrifissures *iv1* and *iv2* slit-like located slightly behind setae *st1* and between *st2-st3* respectively. Metasternal setae (*st4* 12–15) on soft cuticle, lyrifissures *iv3* absent or obscure; endopodal platelets II-III and III-IV narrow and fused to lateral margins of sternal shield. Epigynal shield pad-shaped, narrowing conspicuously posterior of *st5*, 175–180 long and 88–93 wide at widest point (middle of wide part 122–125 long, above the insertion of *st5*) and 25–27 at narrowest point (middle of narrow part 53–55 long), anterior hyaline margin rounded, extending to level of *st3*; narrow portion with rounded posterior margin, genital setae *st5* 10–12, placed on posterolateral margins of wide portion and associated lyrifissures *iv5* on soft integument, slightly behind *st5*. Anal shield 76–83 long (with cribrum) and 82–85 wide, triangle-shaped, punctate-reticulate on lateral portion, median surface smooth; postanal setae 22–25 long, slightly thicker and shorter than para anal setae (24–27); cribrum with a narrow band of spicules, anal gland pores (*gv3*) absent or obscure. Lateral and opisthogastric soft integument with 10 pairs of smooth setae, *R* setae (12–14), *ZV1* (11–13), *ZV2* (13–15), *ZV3-4* (12–14), *ZV5* (24–26), *JV1* (11–13), *JV5* (25–28), with one pair of ventral pores near *ZV3,* other ventral pores obscure or absent. Metapodal plates absent. Peritreme short, extending just beyond the posterior margin of coxa II*,* peritrematal plate absent. Exopodal platelet narrow and curved behind coxae IV. Stigma located between coxae III-IV.



Figures 4–5. Photographs of *Myrmozercon brachiatus* (female) – 4. Dorsal idiosoma; 5. Ventral idiosoma.

Gnathosoma (**Fig. 7**) **–** Epistome (Fig. 2) smooth, edentate, arc-shaped. Corniculi short, irregularly formed, horn-like, shorter than internal malae; internal malae with a pair of adjacent median projections, and pair of sparsely dentate projections at lateral edges. Labrum acuminate, pilose, conspicuously longer than internal malae. Deutosternal furrow on ventral subcapitulum with seven transverse rows of denticles, each with 7–9 denticles. Lengths of hypostomal and palpcoxal setae: *h1*, *h3* and *pc* 14–16, *h2* 7–9. Chelicerae (Fig. 8) typical for genus, moveable digit (21–25) with

two small teeth, middle article (53–58) ending in fixed digit (7–10) with a single small tooth, pilus dentilis and cheliceral seta absent. Palp (78–83), chaetotaxy normal, (sensu Evans and Till 1966), with simple setae; palp apotele two-tined (Fig. 7) with 19–22 long from base to anterior tip of longer fork.



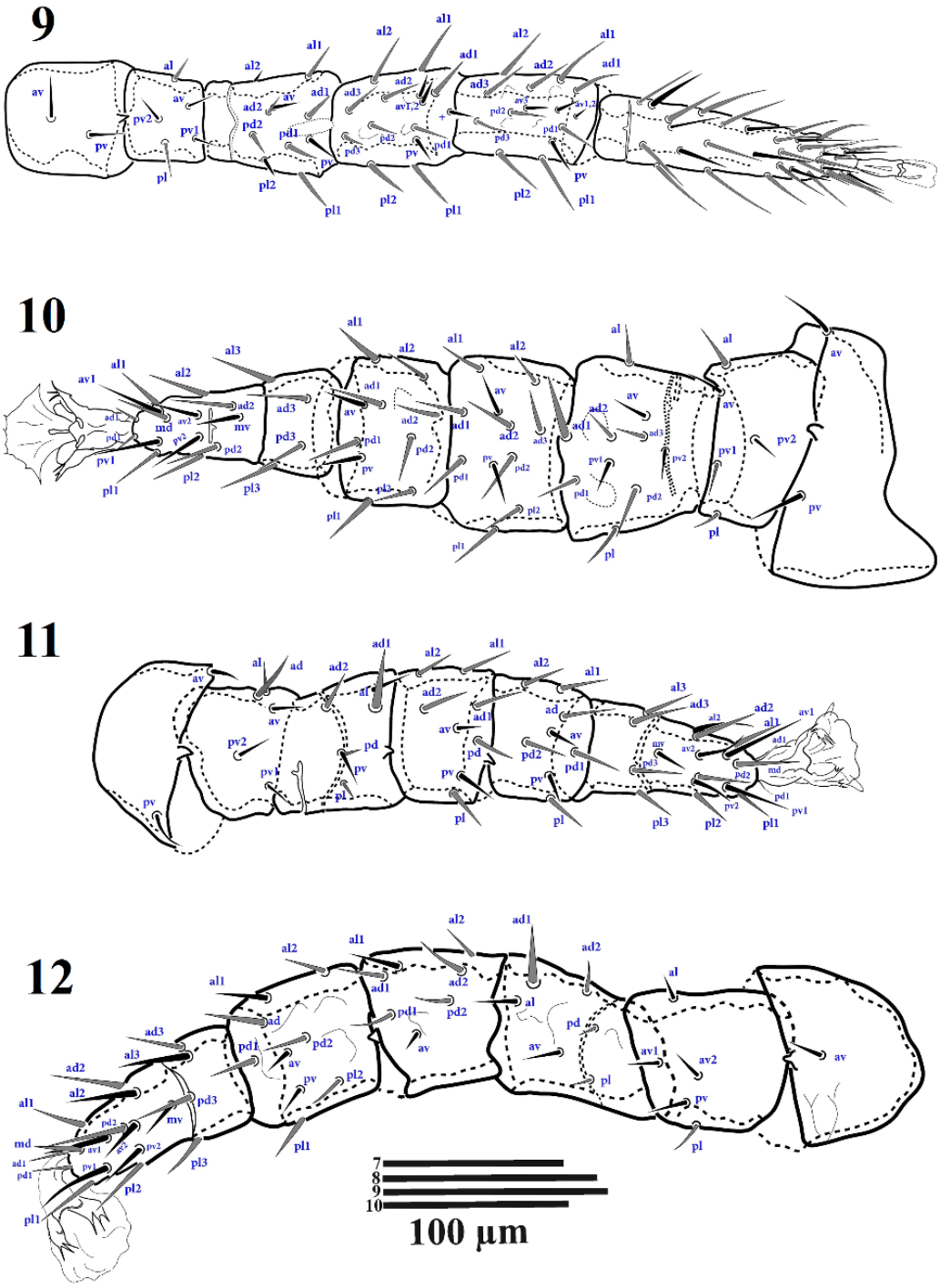
Figures 6–8. *Myrmozercon brachiatus* (female) – 6. Ventral idiosoma; 7. Ventral gnathosoma with palp; 8. Chelicera.

Legs (**Figs. 9–12**) **–** Tarsi I–IV each with rudimentary claws and distinct pulvillus. Lengths of legs: leg I 390–434, leg II 285–320, leg III 222–275, leg IV 368–397. Coxae I–IV: 2 (0 0/1, 0/1 0), 2 (0 0/1, 0/1 0), 2 (0 0/ 1, 0/1 0), 1 (0 0/1, 0/0 0); trochanters I–IV: 5 (1 0/1, 0/2 1), 5 (1 0/1, 0/2 1), 5 (1 1/1, 0/2 0), 5 (1 0/2, 0/1 1); femora I–IV: 10 (2 2/1, 2/1 2), 10 (1 3/1, 2/2 1), 6 (1 2/0, 1/1 1), 6 (1 2/1, 1/0 1); genu I–IV: 13 (2 3/2+1, 3/1 2) (+1 only on right leg in one specimen), 11 (2 3/1, 2/1 2), 8 (2 2/1, 1/1 1), 7 (2 2/1, 2/0 0)); tibiae I–IV: 14 (2 3/3, 3/1 2), 10 (2 2/1, 2/1 2), 8 (2 1/1, 2/1 1), 9 (2 1/1, 2/1 2); tarsi II–IV: 18 (3 3/2, 3/2 3 + mv, md). Seta *ad* on trochanter III, *pd1–2* and *pl1* on femur I, *ad1* on femur I–IV, *pl1–2* on genu I thicker than other setae. Genu I with a supernumerary seta on right leg in only one specimen.

Male – Unknown.

Remarks

Myrmozercon brachiatus differs from all congeners by the presence of combination characters as follows: five pairs of *J-series* setae (*J1-J5*), shape of the genital shield (strongly constricted after insertion of setae *st5*), sternal shield with a deep notch anteromedially at level of tritosternum placement, with indistinct posterior margin, lateral margins slightly sclerotized, and genu IV with seven setae (*pl* absent). In addition, we studied detailed photomicrographs of three females on the slides (Nos. 6M/1, 6M/2, M5/50) of the Berlese Acaroteca deposited in Florence, Italy.



Figures 9–12. *Myrmozercon brachiatus* (female) – 7. Leg I; 8. Leg II; 9. Leg III; 10. Leg IV.

In the original description and illustration of *M. brachiatus* (Berlese, 1904, Figs. 156–157), anterior margin of sternal shield without notch, setae *st5* are obviously absent, there are two unpaired setae on dorsal shield, and setae *J5* absent but these were all inaccurate, and in the all detailed photomicrographs we studied, anterior margin of sternal shield was with notch, setae *st5* present (in 6M/1 and 6M/2 slides, from personal notes of Peter Mašan), dorsal shield without unpaired seta between *J-series* and setae *J5* are obviously present.

By comparing the description of Berlese (1904, Figs. 156–157) and our observations on Iranian specimens, we could find small differences in some characters as follows:

In our Iranian specimens, genital shield was slightly wider than Berlese's specimens and podonotal setae significantly shorter than opisthonotal setae (Figs. 1, 4), but in type specimens, podonotal setae were longer, however still shorter than opisthonotal setae. In Iranian specimens, there are eight pairs of ventral setae, but 10 pairs in Berlese's specimens (see Fig. 156 in Berlese 1904). We believe that such morphological differences may represent intraspecific variation in two different geographical zones.

Moreover, *M. brachiatus* was collected by Berlese (1903) from the nest of *Messor barbarus capitatus* var. *minor* (Hymenoptera: Formicidae). Now, this ant species is *Messor capitatus* (Latreille, 1798) which has been raised to the species level from the subspecies level. On other hand, Iranian specimens were collected from the nest of *Messor mediosanguineus* Donisthorpe, 1946, which previously was *Messor barbarus mediosanguineus* Donisthorpe, 1946. This ant subspecies was raised to the species level by Khalili-Moghadam *et al*. (2019). So, this subject shows that *Myrmozercon* is rightly thought to be host-specific. Hence, probably the taxonomic changes in ants are reflected by the species of *Myrmozercon* living with them. To date, 27 species of *Myrmozercon* have been described globally (De Moraes *et al*. 2022), many of which are known only from their type material.

Given that the morphology-defined species boundaries have been ambiguous, there has been much disagreement on species placement, especially since there is little information about the type species of the genus *Myrmonyssus*.

The specimens of *M. brachiatus* from Iran are the first to be reported in the literature after more than one hundred years since this species was described by Berlese (1903). The discovery of *M. brachiatus* in south-west Iran expands the previously documented distribution range of this species by about 3400 km to the east. Although the laelapid fauna of Iran is relatively well studied, there are still some understudied regions. A more complete knowledge of the diversity of the laelapid mite in the country could be revealed only after carrying out further studies in these poorly-examined regions.

ACKNOWLEDGMENT

This work has been financially supported by the research deputy of Shahrekord University under grant number 141/5900 which is greatly appreciated. We are thankful to Dr. Sauro Simoni (Research Director at CREA Council for Agricultural Research and Economics, Florence, Italy) for sending photos of type materials and Prof. Peter Mašan (Institute of Zoology, Slovak Academy of Sciences, Bratislava, Slovakia) for sending personal notes from type materials.

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بازکشف *Myrmozercon brachiatus* Berlese (Acari: Mesostigmata) در جنوب غرب ایران

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چکیده

گونهٔ *Myrmozercon brachiatus* Berlese, 1903 (Mesostigmata: Laelapidae)، که در ابتدا از پورتیسی، ناپل ایتالیا در سال ۱۹۰۳ توصیف شد، برای نخستین بار از لانهٔ *Messor mediosanguineus* Donisthorpe و با استفاده از مقایسه با عکس‌های هولوتیپ آن بازکشف شد. دو نمونه کنهٔ ماده در منطقه بن در استان چهارمحال و بختیاری جمع آوری شدند. این یافته جدید، بسیار دورتر از محل جمع‌آوری نمونهٔ تایپ، نشان دهنده پراکنش بیشتر این گونه در ناحیهٔ پالئارکتیک است. بازتوصیف ریخت‌شناختی این دو نمونه ارایه شده است.

واژگان کلیدی: ایران؛ Laelapidae؛ کنه‌های مورچه‌دوست؛ بازتوصیف؛ آرایه‌شناسی.

اطلاعات مقاله: تاریخ دریافت: ۱۴۰۱/۱۰/۷، تاریخ پذیرش: ۱۴۰۱/۱۲/۵، تاریخ چاپ: ۱۴۰۲/۱/۲۶