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Article

Gaeolaelaps hajiqanbari sp. nov. (Acari: Mesostigmata: Laelapidae) from Western Siberia, Russia

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ABSTRACT

This paper reports on a new species of mite of the genus *Gaeolaelaps* from Western Siberia, Russia, *Gaeolaelaps hajiqanbari* Joharchi & Nemati **sp. nov.** collected from soil of a salt marsh in vicinity of Omsk. The new species is described, and illustrations provided based on morphological characters of the adult female.

KEY WORDS: Asian Russia; Dermanyssoidea; Gamasina; Palaearctic Region; Parasitiformes; taxonomy.

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INTRODUCTION

Members of the subfamily Hypoaspidinae (Mesostigmata: Laelapidae) have mostly been reported from soil-litter habitats and many species are important beneficial predators of agricultural pests (Rosario 1981; Strong and Halliday 1994; Beaulieu 2009; Faraji and Halliday 2009; Lindquist *et al.* 2009; Nemati and Mohseni 2013).

Gaeolaelaps Evans & Till, 1966 is well known as a group of predatory mites that are among the most commonly encountered hypoaspidins in soils. Based on the few species studied, they prey on nematodes, acarid mites and other soft-bodied arthropods that abound in soil and decomposing organic matter. They may therefore play an important role in the balance of the soil ecosystem (Gerson *et al.* 2003; Lindquist *et al.* 2009). Until now, many species of soil-inhabiting laelapid mites have been reported from Russia, but most of them are recorded from European part (Bregetova 1977). Nevertheless, the family Laelapidae, and especially the genus *Gaeolaelaps* remains poorly studied in Asian part. The limited information regarding to some *Gaeolaelaps* species in Southern and Western Siberia was recognized by Davydova (1977), Davydova and Nikolsky (1986), and Marchenko (2011, 2012a, b). The most recent works were carried out by Joharchi *et al.* (2019, 2020, 2021), who described and reported some free-living and myrmecophilous species of *Gaeolaelaps* from Altai

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Mountains and Western Siberia. Herein, we expand this study to include a new species from soil of a salt marsh in Omsk region, Western Siberia.

MATERIAL AND METHODS

Mites were extracted from soil-litter samples using Berlese-Tullgren funnels, cleared in lactic acid solution and mounted in Hoyer's medium (Walter and Krantz 2009). The line drawings and examinations of the specimens were performed with Zeiss Axio Imager A2 and Leica DM 2500 compound microscopes equipped with drawing tubes and differential interference contrast and phase contrast optical systems, attached to cameras AxioCam ICc 5 and ICC50 HD, respectively. Most images were captured in stacks (with focal depth manually controlled). Selected images were combined using Helicon Focus 7.6.4 Pro (Helicon Soft Ltd, 2000). Digital drawings were prepared using Adobe Photoshop CS2 based on the original pencil line drawings. Images and morphological measurements were taken via ZEN 2012 software (version 8.0) and Leica Application Suite (LAS) (version 4.2, Live and Interactive Measurements modules). Photomicrographs were taken with an AxioCam 506 camera (Carl Zeiss, Germany). Measurements of structures are expressed as ranges (minimum–maximum) in micrometres (μm). The length and width of the dorsal shield were taken from the anterior to the posterior margins along the midline, and at level of *r3*, respectively. Length and width of the sternal shield were measured at the maximum length and broadest points (at level between coxae II and III), respectively. The length of the genital shield was measured along the midline from the anterior margin of the hyaline extension to the posterior margin of the shield, and its width where maximal, posterior to genital setae *st5*. Leg length was measured from the base of the coxa to the apex of the tarsus (excluding the pre-tarsus). The nomenclature used for the dorsal idiosomal chaetotaxy follows that of Lindquist and Evans (1965), the notations for leg and palp setae follow those of Evans (1963a, b), and other anatomical structures follow Evans and Till (1979). Notations for idiosomal pore-like structures (gland pores and poroids/lyrifissures) and peritrematal shield follow Athias-Henriot (1971, 1975). Notations for idiosomal pore-like structures (gland pores and poroids/lyrifissures) and peritrematal shield follow Athias-Henriot (1971, 1975). The notations for pore-like structures on the sternal shield and for the peritrematal shield region also follow modifications and additions by Johnston and Moraza (1991), Kazemi *et al.* (2014) and Makarova (2003) for gland pore *gvb*. The supralabral process is described *sensu* Kazemi (2020). The holotype and paratypes are deposited at the Acarological Collection of the Tyumen State University Museum of Zoology, Tyumen, Russia (TUMZ).

RESULTS

Genus *Gaeolaelaps* Evans & Till, 1966

Hypoaspis (*Gaeolaelaps*) Evans & Till 1966: 159.

Type species: *Laelaps aculeifer* Canestrini, 1884, by original designation.

Diagnosis

The concept of *Gaeolaelaps* used here is based on that of Beaulieu (2009) with modifications by Kazemi *et al.* (2014).

***Gaeolaelaps hajiqanbari* Joharchi & Nemati sp. nov. (Figs. 1–20)**

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Diagnosis (female)

Female with dorsal shield gently tapering from level of *S4* setae, with rounded shape of the

Description (female, n = 7)

Dorsal idiosoma (Figs. 1, 7) – Dorsal shield oval-shaped, 547–555 long, 310–331 wide, reticulation more distinct in the lateral sections, covering most of dorsal idiosoma but leaving narrow strip of soft lateral cuticle; shield narrowing from level of setae *r3*, progressively tapering until *s6*, then subparallel from *S1* to level of *S3*, where it then gently tapers until rounded posteriorly; shield with 39 pairs of setae of almost uniform length (34–43), except setae *j1* (43–45), *z1* (21–23) shortest, *Z5* (54–62) longest, all setae relatively long and reaching base of following setae, setae of central area shorter (not reaching base of following setae); setae *J5*, *Z5* and *S5* with 1–3 small barbs (Figs. 1, 7); without unpaired setae. Shield with about 20 pairs of discernible pore-like structures, including 16 poroids and four gland openings; lacking apparently gland openings *gd1*, *gd4*, *gd5*, see Figures 1 and 7.

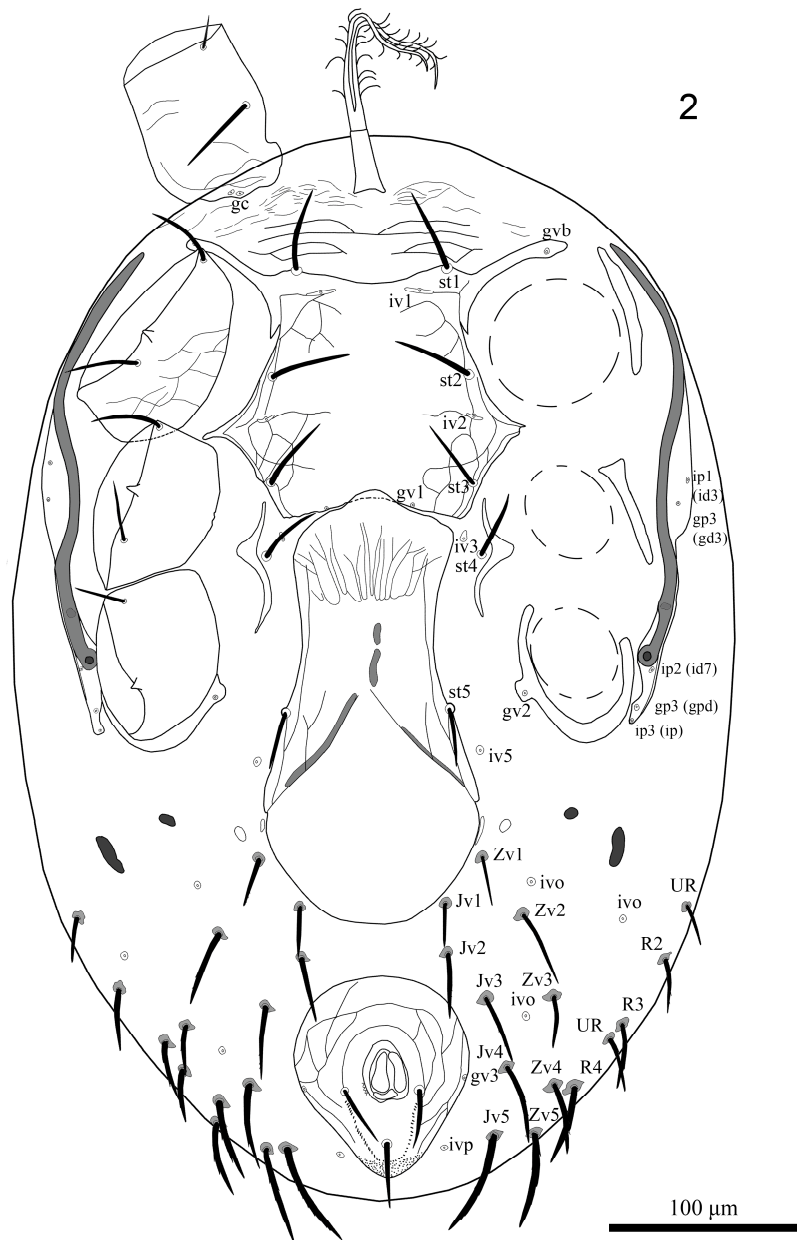
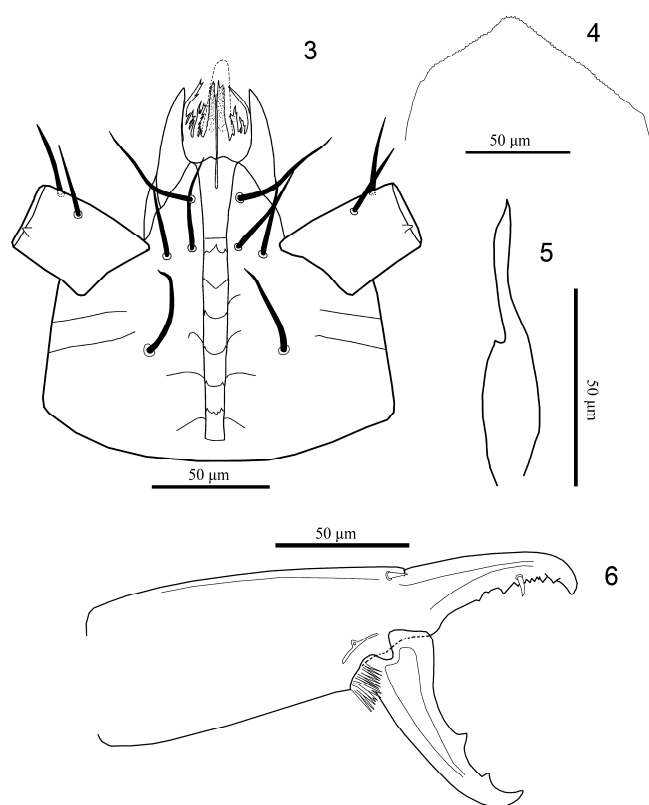
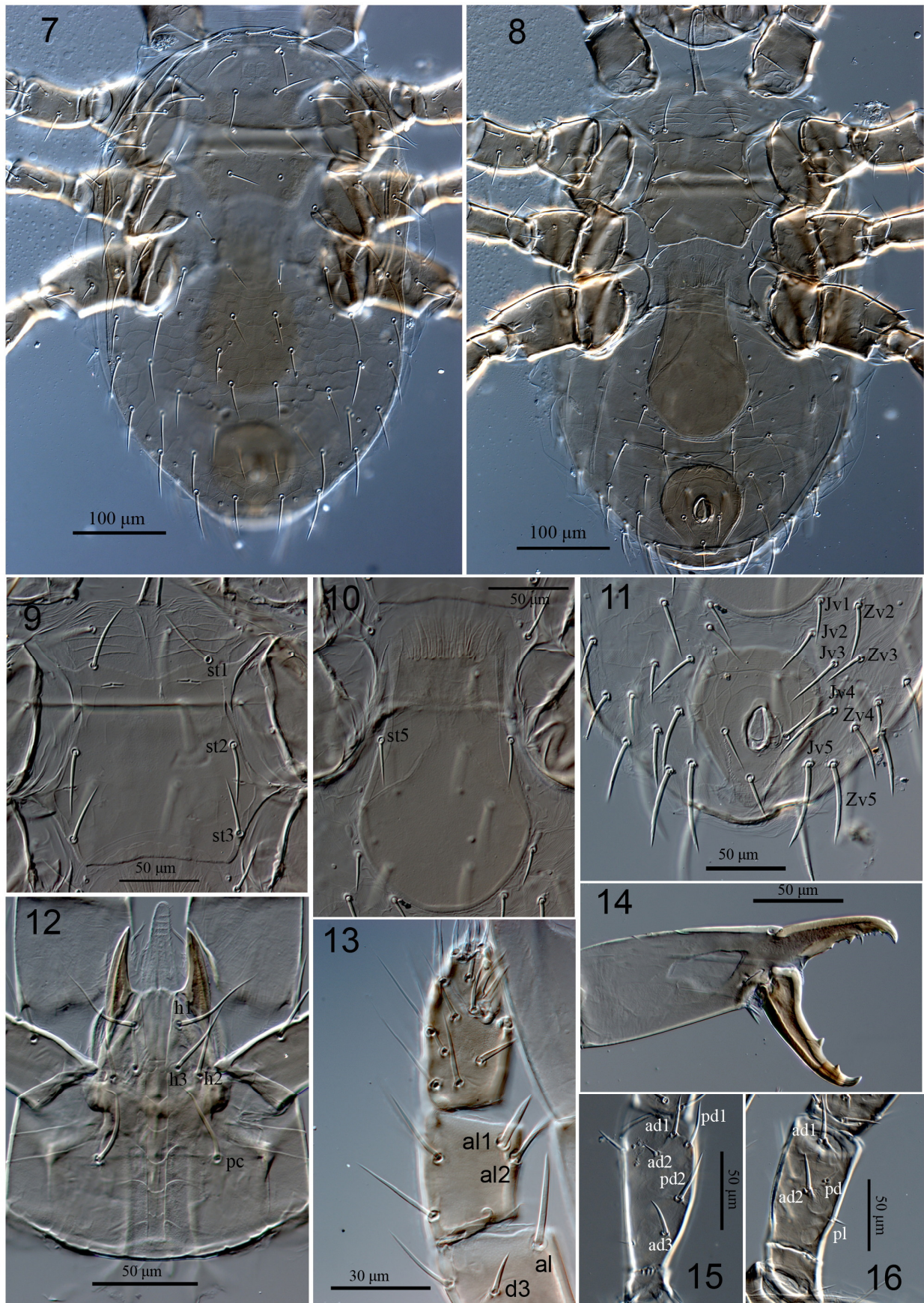


Figure 2. *Gaeolaelaps hajiqanbari* Joharchi & Nemati **sp. nov.** (female) – Ventral idiosoma.

Ventral idiosoma (Figs. 2, 8–11) – Tritosternum with paired pilose laciniae (104–113), fused basally (10–13), columnar base $30\text{--}36 \times 14\text{--}16$ wide; presternal area lightly sclerotized, with a few transverse curved lines. Sternal shield (length 110–116) narrowest between coxae II (95–99), widest (160–171), anterior and posterior margin of shield moderately concave, anterolateral corners narrowly extending between coxae I–II, distally bearing gland pores *gvb*; endopodal elements between coxae II and III fused with shield; with a small triangular protuberance on outer lateral sides at level between setae *st1* and *st2* (in all examined specimens), shield bearing gland pores *gv1* and three pairs of smooth setae (*st1* 43–45, *st2* 39–42, *st3* 39–42) and two pairs of slit-shaped pore-like structures (*iv1* adjacent to setae *st1*; *iv2* between *st2* and *st3*), setae not reaching base of next setae; sternal shield with reticulate ornamentation in longitudinally lateral parts, longitudinally median part smooth (or faintly reticulated) (Figs. 2, 8, 9). Metasternal setae *st4* (34–36) and metasternal poroids located on soft integument; metasternal platelets absent. Endopodal plates II/III completely fused to sternal shield, endopodal plates III/IV elongate, narrow and curved. Genital shield flask-shaped, slightly expanded laterally past level of setae *st5* (Figs. 2, 8, 10), length 215–224, maximum width 110–115, posterior margin rounded, anterior hyaline margin of shield irregularly convex and usually slightly covering posterior margin of sternal shield, with an inverse Y-shaped ornamentation, otherwise smooth; genital shield separated from anal shield by almost length of anal opening, setae *st5* (30–32) inserted on lateral margins of shield, approximately at level of posterior edge of coxae IV. Poroids *iv5* inserted on soft cuticle, at level of tip of *st5*. Two tiny postgenital sclerites at level of *Zv1* present. Anal shield subtriangular, 101–105 long, 83–89 wide, with lineate-reticulate ornamentation, anterior margin of shield rounded, circumanal setae smooth, postanal seta (32–35) slightly longer than para-anal setae (30–32); cribrum well developed, with two single rows of spicules each extending from cribrum to near base of para-anal setae; anal opening located at mid-level of shield; pair of glands *gv3* inserted on shield lateral margins, at level between para-anal setae and posterior edge of anus (Figs. 2, 8, 11).



Figures 3–6. *Gaeolaelaps hajiqaanbari* Joharchi & Nemati **sp. nov.** (female) – 3. Subcapitulum; 4. Epistome; 5. Supra-labral process; 6. Chelicera.



Figures 7–16. DIC micrographs of *Gaeolaelaps hajiqanbari* Joharchi & Nemati **sp. nov.** (female) – 7. Idiosoma in dorsal view; 8. Idiosoma in ventral view; 9. Sternal shield; 10. Genital shield; 11. Anal shield and soft opisthogastric cuticle; 12. Subcapitulum; 13. Distal portion of palp, with a focus on apotele; 14. Chelicera; 15. Fe I; 16. Fe IV.

Peritrematal shield narrow developed posteriorly beyond stigmata, almost reaching posterior margin level of coxae IV, extending anteriorly and fused to dorsal shield at base of level seta *z1*; bearing two gland pores (*gp*) and three poroids (*ip*) (including post-stigmatic section that bearing three pore-like structures, two lyrifissures *ip* and a gland pore *gp*) (Fig. 2), peritremes extending from stigmata to level of acetabulum I (Fig. 2). Exopodal platelets between coxae II–III divided into sclerotized strips along coxae II and III, those behind coxae III–IV and parapodal platelets fused, strip-like, extending narrowly behind coxae IV, bearing gland pore *gv2*. One pair of minute paragenital platelets anterior to setae *ZVI*. Soft opisthogastric cuticle bearing 15 pairs thick setae, each arising on minute sclerotized platelet and mostly with 1–4 small barbs and four pairs of poroids (four *ivo*; *ivp*), *Jv1*, *Jv2* (29–32), *Jv3* (35–39), *Jv4* (42–45), *Jv5* (56–59), *Zv1* (25–27), *Zv2* (37–40), *Zv3* (26–28), *Zv4* (36–38), *Zv5* (50–54), two pairs of metapodal plates present, the anterior small, ovoid and the posterior larger, fusiform (20–26 long × 5–7 wide) (Figs. 2, 8, 11).

Gnathosoma (Figs. 3–6, 12–14) – Epistome subtriangular, and irregularly denticulate (Fig. 4). Internal malae fringed, with a pair of thick, contiguous median projections, and two pairs of thinner lateral projections, the inner pair shortest. Labrum considerably short (slightly longer than horn-like corniculi), with completely rounded apex (Figs. 3, 12). Hypostomal setae smooth, *h1* (48–50) > palpcoxal *pc* (39–41) > *h3* (37–39) > *h2* (27–30) (Figs. 3, 12). Deutosternum with six rows of two denticles close to each of lateral margins except first and last rows, with three and four denticles, respectively (Figs. 3, 12). Chaetotaxy of palps: trochanter 2, femur 5, genu 6, tibia 14, tarsus 15, all setae needle-like except *al1* and *al2* of palpgenu and *al* of palpfemur thickened, palptarsus apotele with two tines (Fig. 13). Supralabral process with a narrow and undivided projection (Fig. 5). Fixed digit of chelicera with an offset and subapical tooth (gabelzhan), followed by 8–9 teeth, a setaceous pilus dentilis, dorsal cheliceral seta prostrate, arthrodial membrane with a rounded flap and normal filaments; cheliceral lyrifissures distinct, movable digit of chelicera bidentate (Figs. 6, 14).

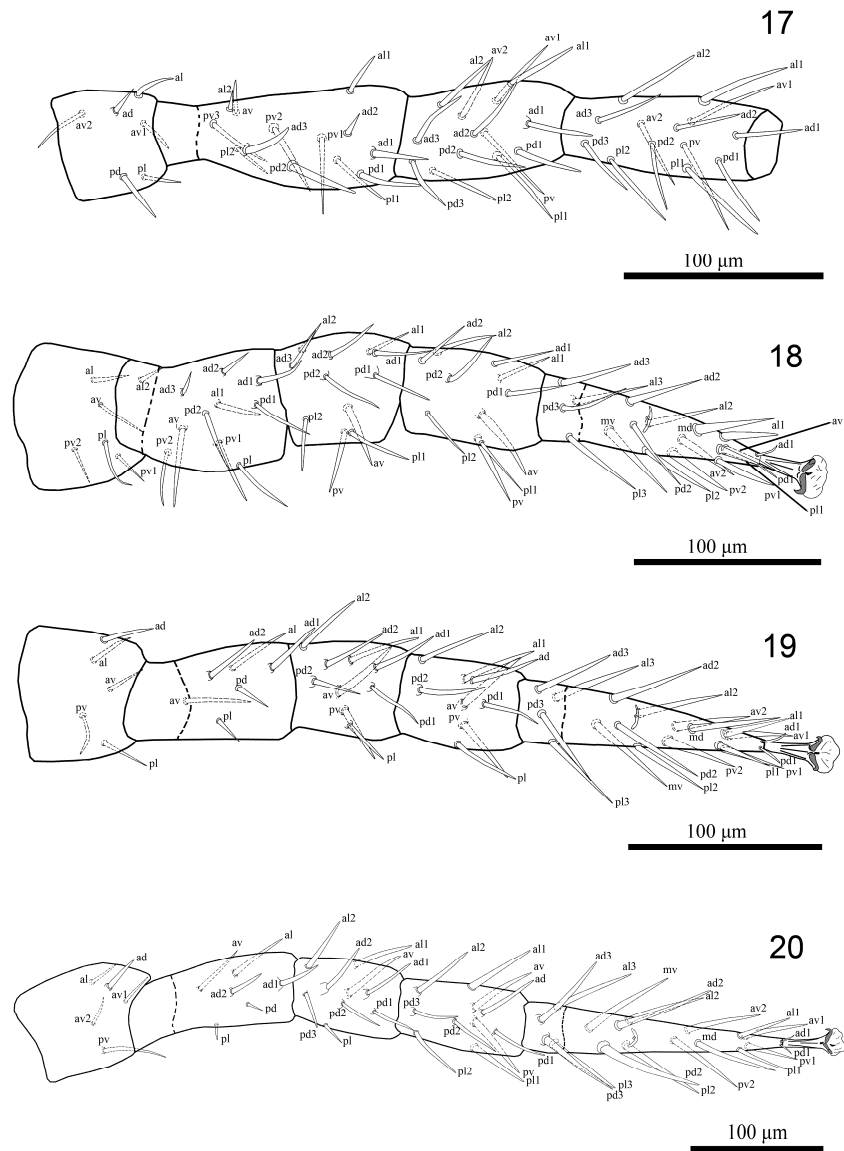
Legs (Figs. 17–20) – Legs II (452–458) and III, (442–450) short, I (607–612) and IV (639–645) longer. Chaetotaxy normal for free-living Laelapidae: Leg I (Fig. 3A): coxa 0-0/1, 0/1-0, trochanter 1-1/2, 1/0-1 (*al*, *ad* and *pd* thickened), femur 2-2/1, 3/3-2 (all dorsal thickened and *ad1* inserted on small tubercles, Fig. 15), genu 2-3/2, 3/1-2 (*ad1* inserted on small tubercles), tibia 2-3/2, 3/1-2. Leg II (Fig. 18): coxa 0-0/1, 0/1-0, trochanter 1-0/1, 0/2-1, femur 2-3/1, 2/2-1 (all dorsal thickened and inserted on small tubercles), genu 2-3/1, 2/1-2 (*av* thickened and *pd1*, *pd2* inserted on small tubercles), tibia 2-2/1, 2/1-2 (ventral setae thickened). Leg III (Fig. 19): coxa 0-0/1, 0/1-0, trochanter 1-1/1, 0/1-1, femur 1-2/1, 1/0-1, genu 2-2/1, 2/1-1 (ventral setae thickened and dorsal setae inserted on small tubercles), tibia: 2-1/1, 2/1-1 (ventral setae thickened and *pd1*, *pd2* inserted on small tubercles). Leg IV (Fig. 20): coxa 0-0/1, 0/0-0, trochanter 1-1/2, 0/1-0 (*ad* thickened and inserted on small tubercles), femur 1-2/1, 1/0-1 (*ad1*, *ad2* thickened and inserted on small tubercles, Fig. 16), genu 2-2/1, 3/0-1 (*av* thickened and *ad1*, *ad2* inserted on small tubercles), tibia 2-1/1, 3/1-2 (*al1*, *pl1*, *av*, *pv* thickened and *al2*, *pd3* inserted on small tubercles). Tarsi II–IV with 18 setae (3- 3/2, 3/2-3 + *mv*, *md*); almost all setae on tarsus II–IV thickened, see Figures 18–20. All pretarsi with well-developed paired claws, rounded pulvilli and normal ambulacral stalk.

Insemination structures – Not seen, apparently unsclerotized.

Male and immatures – Unknown.

Etymology

This species is named in honor of our friend and colleague, a famous acarologist, Dr. Hamidreza Hajiyanbar (Tarbiat Modares University, Tehran, Iran), for his extensive contributions to our knowledge of morphology, systematics and phylogenetics of heterostigmatic mites. He passed away unexpectedly on October 2021, at the age of 48, resulting in an irretrievable loss for the international scientific community.



Figures 17–20. *Gaeolaelaps hajiqanbari* Joharchi & Nemati **sp. nov.** (female) – 17. Leg I (trochanter-tibia); 18. Leg II; 19. Leg III; 20. Leg IV.



Figure 21. Collecting site in Nazyvayevsky District, Omsk Oblast, Western Siberia, Russia.

Type material

Holotype, female, Nazyvayevsky District, Omsk Oblast, Western Siberia, Russia (Fig. 21), 55° 31' N, 70° 49' E, 27 August 2020, A.A. Khaustov coll., from soil of salt marsh (in TSUMZ). Paratypes, six females, same data as holotype (in TSUMZ).

Remarks

The new species can easily be distinguished from all members of *Gaeolaelaps* by having relatively unique characters: seta *st1* on pointed edge of two anterior extensions of sternal shield. In most species of *Gaeolaelaps* the seta *st1* is well located inside the sternal shield, seta *st1* is off the sternal shield in the presternal region in only eight species of *Gaeolaelaps* (see Kafi *et al.* 2020). This feature can be difficult to discern, and in some of these species seta *st1* is on pointed edge of two anterior extensions of shield, as was found just in two described species of *Gaeolaelaps* - *G. jondishapouri* Nemati and Kavianpour, 2013 and *G. changlingensis* (Ma, 2000). The new species is closely related to *G. jondishapouri* [redescribed by Kazemi *et al.* (2014)] and *G. changlingensis* (Ma, 2000) by sharing this character state which is described from Iran and China, respectively. *Gaeolaelaps hajiqaanbari* differs from both *G. jondishapouri* and *G. changlingensis* by the rounded shape of the posterior region of the dorsal shield (Figs. 1, 7), while in both *G. jondishapouri* and *G. changlingensis* this region is described as V-shaped (subtriangular) or bell-shaped; genital shield long, extending close to anal shield, the distance midline between posterior margin of genital shield and anterior margin of anal shield at most as long as anal opening in *G. hajiqaanbari* (Figs. 2, 8, 11), while genital shield much shorter, the distance midline between posterior margin of genital shield and anterior margin of anal shield nearly as long as anal shield in both *G. jondishapouri* and *G. changlingensis*; soft opisthogastric cuticle bearing 15 pairs thick setae (e.g. *Jv4*, *Jv5*, *Zv4*, *Zv5* considerably thickened) (Figs. 2, 11), while soft opisthogastric cuticle bearing 8–9 thin and needle-like in both *G. jondishapouri* and *G. changlingensis*; leg I without thickened setae in both *G. jondishapouri* and *G. changlingensis*, while dorsal setae on trochanter and femur I considerably thickened and some inserted on small tubercles in *G. hajiqaanbari* (Figs. 15, 17); *ad1*–*2* on femur IV considerably thickened and some inserted on small tubercles in *G. hajiqaanbari* (Figs. 16, 20), while only *ad2* slightly thickened in *G. jondishapouri*; labrum considerably short (slightly longer than corniculi) with completely rounded apex in *G. hajiqaanbari* (Figs. 3, 12), while labrum acuminate and considerably longer than corniculi in *G. jondishapouri*; fixed cheliceral digit with 9–10 teeth in *G. hajiqaanbari* (Figs. 6, 14), while fixed digit of chelicera at most bearing eight teeth in both *G. jondishapouri* and *G. changlingensis*; dorsal setae mostly simple, except setae *J5*, *Z5* and *S5* with 1–3 small barbs in *G. hajiqaanbari* (Figs. 1, 7), while most of dorsal setae with 1–3 barbs in *G. jondishapouri*; dorsal shield lacking apparently gland openings *gd1*, *gd5* in *G. hajiqaanbari* (Figs. 1, 7), while both are present in *G. jondishapouri*; a strip-like postgenital sclerite is present in *G. jondishapouri*, while apparently absent in *G. hajiqaanbari*, palp apotele with three tines, including a minute basal tine in *G. jondishapouri* (see Kazemi *et al.* 2014), while palp apotele clearly with two tines (without a minute basal tine) in *G. hajiqaanbari* (Fig. 13). All above mentioned morphological differences were confirmed via examination of the type materials of *G. jondishapouri*. The genus *Gaeolaelaps* needs a thorough revision and it is necessary to split it into smaller monophyletic groups. However, we suspect that such a unique character where seta *st1* is on the pointed edge of two anterior extensions of sternal shield occurs in other species, which we may have overlooked, or that are still undescribed, and all species with this character may form a monophyletic group; however, a comprehensive revision of all *Gaeolaelaps* species is necessary to resolve their relationships.

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گونه جدید *Gaeolaelaps hajiqanbari* (Acari: Mesostigmata: Laelapidae) از سیبری

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چکیده

این مقاله در مورد گونه‌ای جدید از کنه از جنس *Gaeolaelaps* – *Gaeolaelaps hajiqanbari* Joharchi and Nematی است که از خاک شوره‌زار در نزدیکی شهر امسک در سیبری غربی جمع‌آوری شده است. گونه جدید توصیف و تصاویر بر اساس ویژگی‌های ریختی ماده بالغ ارائه شده است.

واژگان کلیدی: روسیه آسیایی؛ بالاخانواده؛ *Dermanyssoidea*؛ *Gamasina*؛ منطقه *Palaeartic*؛ *Parasitiformes*؛ آرایه‌شناسی.

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