

A NEW SPECIES OF *RAPHIGNATHUS* DUGÉS (ACARI: RAPHIGNATHIDAE) FROM IRAN

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ABSTRACT: A new species of Raphignathidae, *Raphignathus hatamii* sp. nov. is described from soil under gum bushes, *Astragalus gossypinus* Fisch. (Fabaceae), Hamedan, Hamedan province, Iran. A key to all known Iranian species of the genus *Raphignathus* is provided.

KEY WORDS: Acari, Raphignathidae, *Raphignathus*, predatory mites, Iran

INTRODUCTION

Members of the genus *Raphignathus* Dugés, 1834 are mostly active in soil and feed on the small arthropods so they can be considered as beneficial control agents in soil, in decreasing phytophagous arthropods. To date, 10 species have been recorded and described from Iran, namely: *R. collegiatus* Atyeo, Baker et Crossley, 1961; *R. gracilis* (Rack, 1962); *R. giselae* Meyer et Ueckemann, 1989; *R. africanus* Meyer et Ueckemann, 1989 (Doğan et al. 2012); *R. zhaoui* Hu et al., 1995; *R. aciculatus* Fan et Yin, 2000; *R. hecmataniensis* Khanjani et Ueckemann, 2003; *R. protaspus* Khanjani et Ueckemann, 2003; *R. saboorii* Ghorbani et al., 2011; *R. larestaniensis* Bagheri, Akrami et Majid, 2012. In this paper the female and male of *R. hatamii* sp. nov. is described.

MATERIAL AND METHODS

Litter and soil sample under gum bushes, *Astragalus gossypinus* Fisch. (Fabaceae) were taken to the laboratory for processing and mounted directly in Hoyer's medium. These specimens were measured, identified and drawn by using differential interference contrast microscopy with 1000 × magnification on an Olympus BX51 microscope. All figures were drawn with the help of drawing tube. Body length measurements represent the distance between the base of gnathosoma and the end of idiosoma; width was measured above coxa III. Setae were measured from the setal base to the tip of the setae; distances between setae were measured between setal bases. Legs were measured from trochanter to pre-tarsus.

The terminology and abbreviation used in the description of the new species follows that of Kethley (1990) and Fan et Yin (2000). All mea-

surements are given in micrometers and the measurements of the paratypes are given in parentheses.

Family Raphignathidae Kramer, 1877

Type genus: *Raphignathus* Dugés, 1834

Type species: *Raphignathus ruberrimus* Dugés, 1834

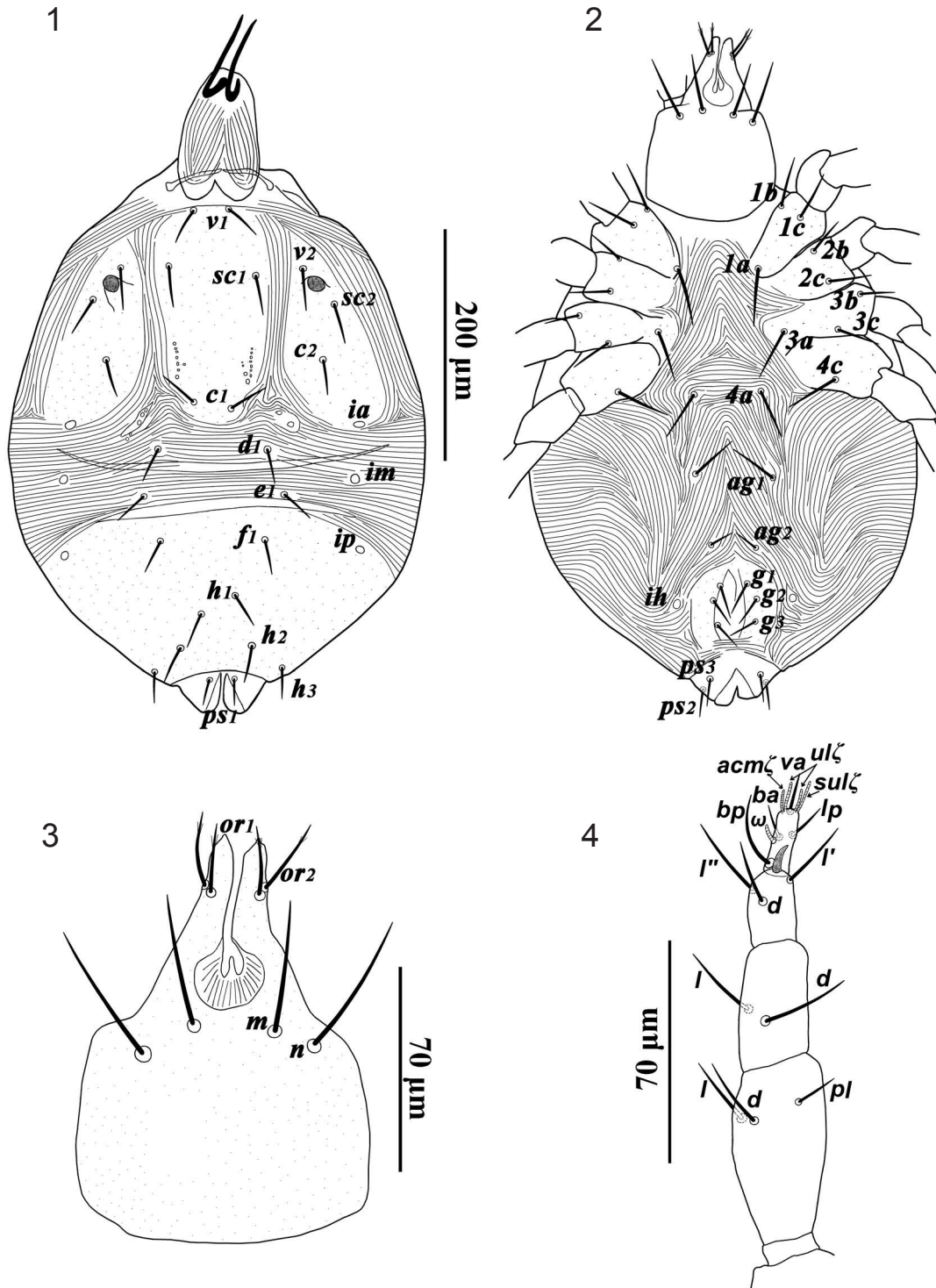
Raphignathus hatamii sp. nov.

Figs 1–17

Female. Diagnosis. Median prodorsal shield with three pairs of setae (v_1 , sc_1 , c_1); interscutal membrane with two pairs of setae; Small shields present posterolateral to median prodorsal shield; dorsal setae simple; palp femur with three setae; femur IV with two setae; tarsi 22 (1♂)–21 (1♂)–15–14.

Type materials. Holotype female, 4 female paratypes and 3 males collected from soil under gum bushes, *Astragalus gossypinus* Fisch. (Fabaceae), Hamedan (34°45'N, 48°31'E and altitude 2015 m above sea level), Hamedan province, Iran, 18, 29 August and 4 September 2010, by Masoumeh Khanjani. The holotype female and 3 female paratypes and 2 males are deposited as a slide-mounted specimen in the Collection of the Acarology Laboratory, University of Bu-Ali Sina, Hamedan, Iran, and one female paratype and one male are deposited in the National Collection of Arachnida, Plant Protection Research, Pretoria, South Africa.

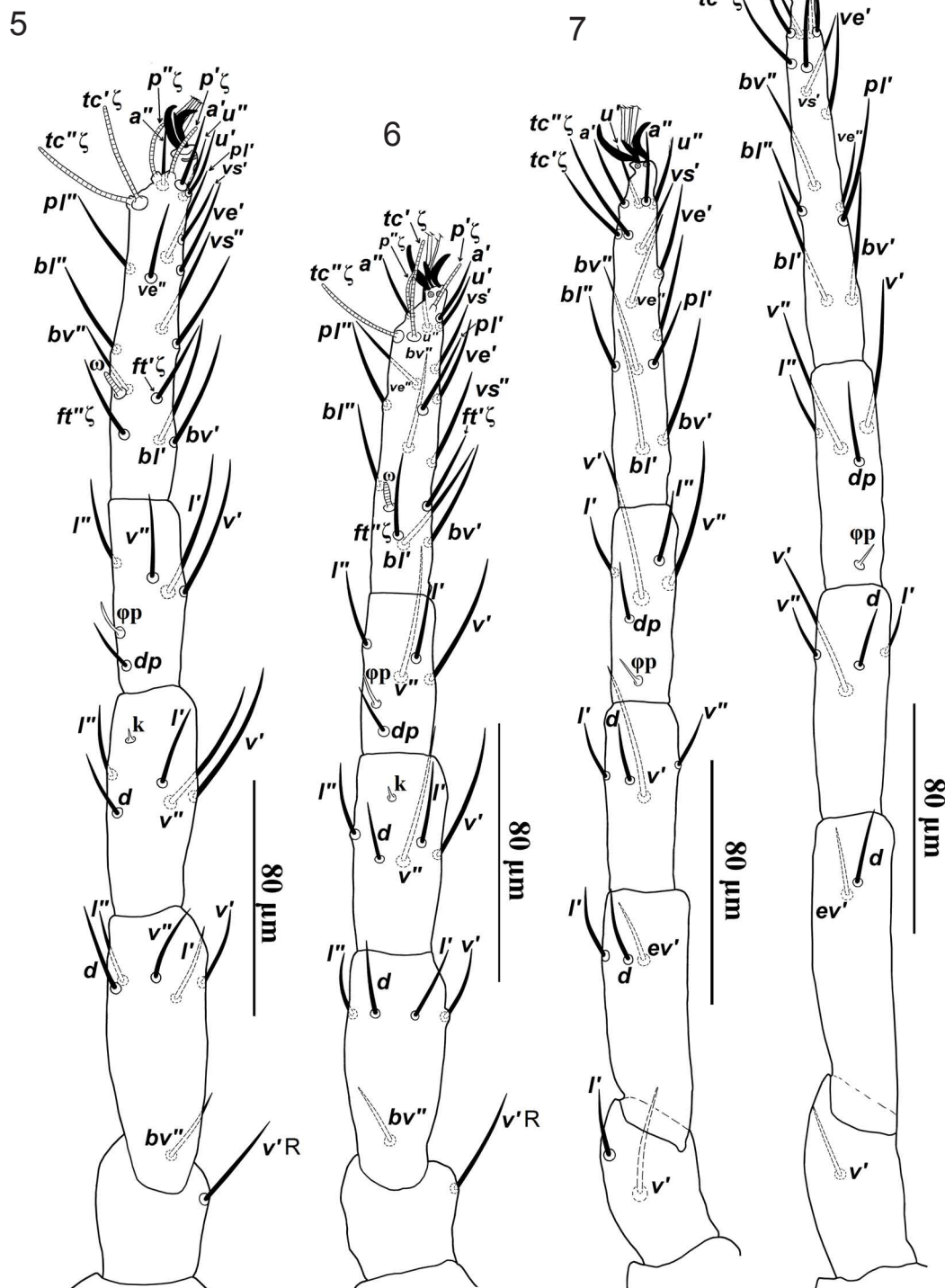
Female (holotype). Color in life red. Idiosoma oval. Length of body (including gnathosoma) 580 (535–620 in 4 paratypes); (excluding gnathosoma) 442 (465–475); width 335 (310–325); length of leg I 339 (330–357); leg II 300 (287–312); leg III 338(330–355), leg IV 419 (387–427).



Figs 1–4. *Raphignathus hatami* sp. nov. Female: 1 — dorsum, 2 — venter, 3 — infrasubcapitulum, 4 — palp.

Dorsum (Fig. 1). Prodorsum with 3 distinct long oval shield, with punctate pattern, median prodorsal shield with 3 pairs of setae (v_1 , sc_1 , c_1) and lateral prodorsal shield with 1 pair of eyes, 3 pairs of setae (v_2 , sc_2 , c_2) (Fig. 1) and 1 pair of cupules (ia); interscutal membrane with 2 pairs of setae (d_1 , e_1), 1 pair of cupules (im) medially and 1 pair of small

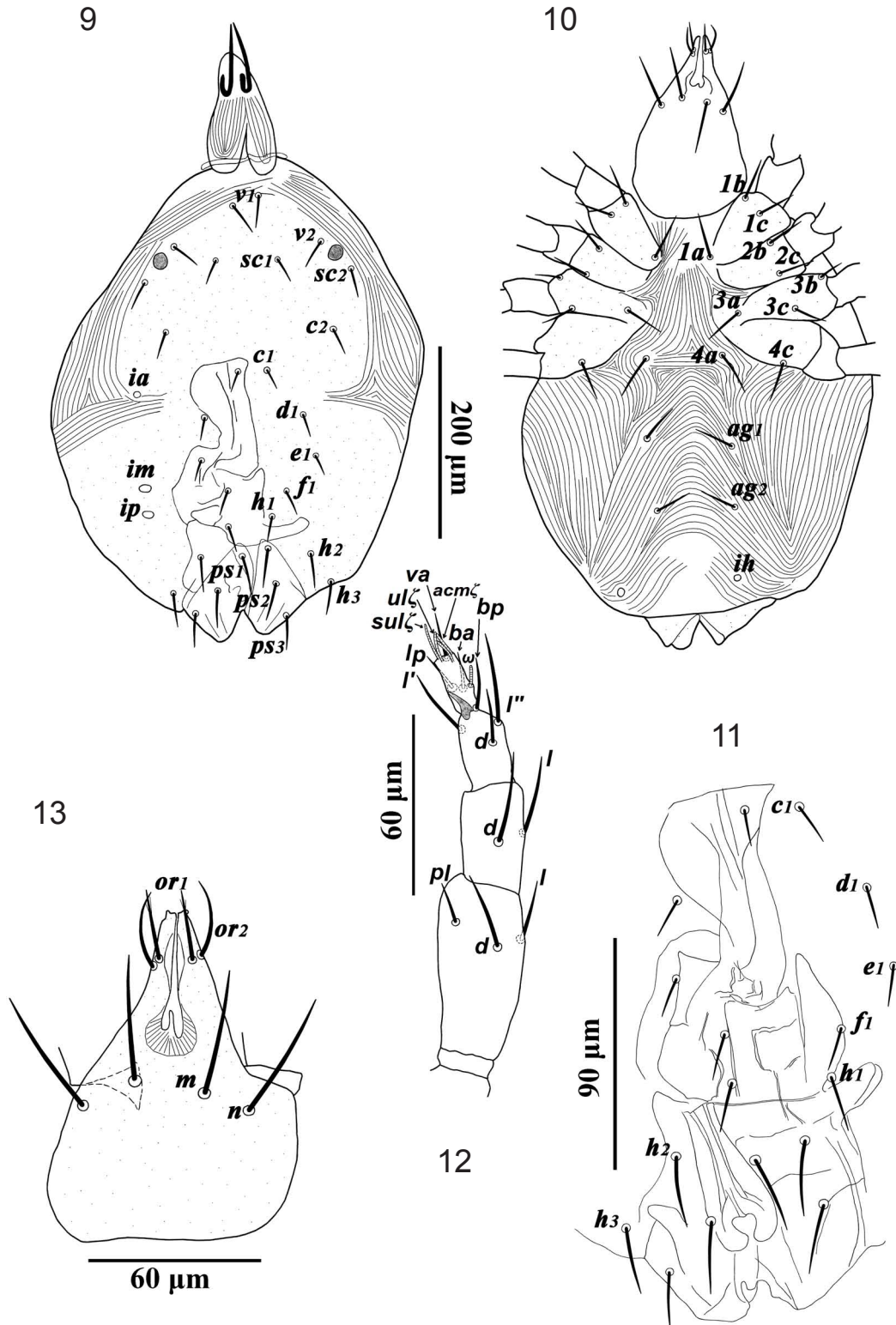
plates behind prodorsal shields; opisthosomal shield with 4 pairs of setae (f_1 , h_1 , h_2 , h_3) and 1 pair of cupules (ip). All dorsal setae are setiform and almost equal in length. Lengths of dorsal setae: v_1 31 (28–34), v_2 36 (27–34), sc_1 34 (27–33), sc_2 35 (29–34), c_1 33 (24–28), c_2 30 (25–29), d_1 30 (24–28), e_1 29 (23–28), f_1 30 (24–30), h_1 31 (25–29), h_2 32 (26–33), h_3 27



Figs 5–8. *Raphignathus hatami* sp. nov. Female: 5–8 — legs I–IV, respectively.

(24–29); distances between dorsal setae: v_1-v_1 27 (24–30), v_2-v_2 148 (120–140), sc_1-sc_1 70 (57–65), sc_2-sc_2 192 (179–190), c_1-c_1 31 (26–31), c_2-c_2 174 (157–190), d_1-d_1 88 (83–91), e_1-e_1 115 (118–127), f_1-f_1 83 (86–94), h_1-h_1

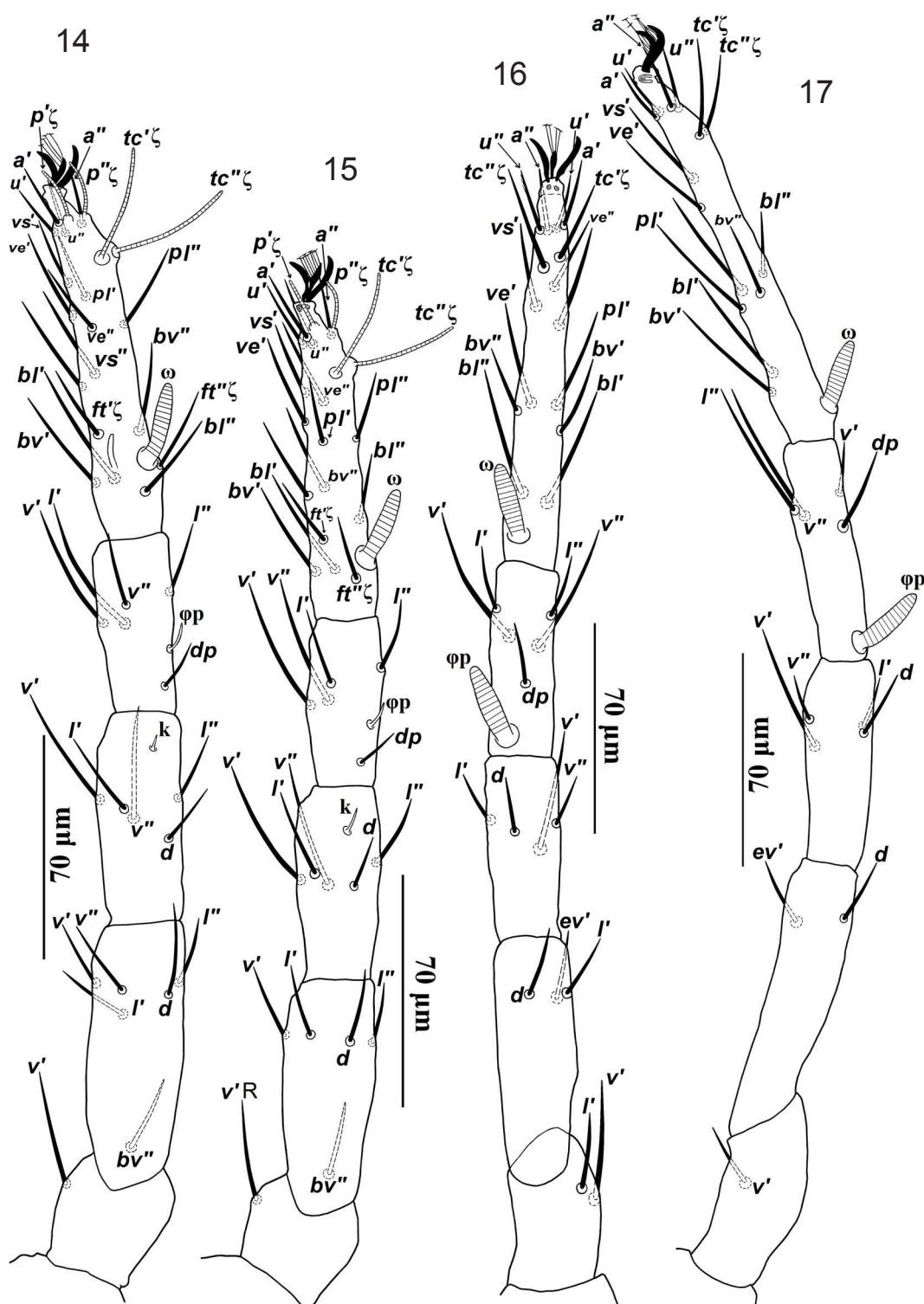
32(32–35), h_2-h_2 57(59–62), h_3-h_3 103(100–108), v_1-sc_1 53 (52–71), v_2-sc_2 31 (34–41), c_1-c_2 82 (75–98), c_1-d_1 47 (26–47), d_1-e_1 39 (45–82), e_1-f_1 42 (43–59), f_1-h_1 59 (40–65), h_1-h_2 39 (35–50), h_2-h_3 31 (22–35).



Figs 9–13. *Raphignathus hatami* sp. nov. Male: 9 — dorsum, 10 — ventral, 11 — genital plate, 12 — palp, 13 — infrasubcapitulum.

Venter (Fig. 2). Ventral idiosoma striated. Coxae III–IV surrounded by punctate endopodal shields (Fig. 2). Length of setae *1a* 48 (42–51), *1b* 41 (34–42), *1c* 40 (30–41), *2b* 30 (30–37), *2c* 33 (29–37), *3a* 42 (37–44), *3b* 27

(22–30), *3c* 34(30–37), *4a* 41 (36–46), *4c* 42(30–40), *ag₁* 39 (34–40), *ag₂* 20(18–23), *g₁* 28 (23–29), *g₂* 24 (21–28), *g₃* 23 (20–24), *ps₁* 23 (24–28), *ps₂* 24 (21–28), *ps₃* 23 (20–26). Aggenital area with 2 pairs of setae (*ag₁₋₂*),



Figs 14–17. *Raphignathus hatami* sp. nov. Male: 14–17 — legs I–IV, respectively.

anal and genital covers separated, each bearing 3 pairs of setae, ps_1 dorsally; 1 pair of cupules (ih) located laterally to genital shield.

Gnathosoma (Figs. 3–4). Ventral infracapitulum with 2 pairs of subcapitular setae, m 47 (43–57) and n 52 (48–53), 2 pairs of adoral setae, or_1 25 (20–31), or_2 28 (24–29) (Fig. 3).

Palp 5-segmented, palp tarsus with 4 simple setae + 1 solenidion (ω) + 4 sub terminal spine-like eupathidia, tibia with 3 simple setae + 1 small claw, palp genu with 2 setae and palp femur with 3 setae (Fig. 4). Chelicera 100 (100–115), movable digits 94 (92–100) long (Fig. 1).

Legs (Figs. 5–8). **Setal formulae of leg segments** as follows: coxae 2–2–2–1; trochanters 1–1–2–1; femora 6–5–3–2, genua 6 (1κ)–6 (1κ)–4–4; tibiae 6 (1φρ)–6 (1φρ)–6 (1φρ)–5 (1φρ); tarsi 22 (1ω)–21 (1ω)–15–14. Length of solenidia: Iω 9 (8–9), IIω 8 (7–9); Iφρ 13 (11–14), IIφρ 11 (11–13), IIIφρ 9 (9–10), IVφρ 10 (8–10); Iκ 5 (6–7), IIκ 5 (5–6).

Male (3 paratypes) (Figs. 9–17). Color in life red. Idiosoma oval. Length of body (including gnathosoma) 515–544; (excluding gnathosoma) 400–417; width 280–342; length of leg I 332–350; leg II 302–320; leg III 373–355, leg IV 395–427.

Dorsum (Fig. 9). Propodosomal shields fused and forms 1 punctate shield with 6 pairs of setae ($v_1, v_2, sc_1, sc_2, c_1, c_2$), a pair of eyes anterolaterally, and 1 pair of cupules (*ia*); interscutal membrane absent; opisthosomal shield with 6 pairs of dorsal setae ($d_1, e_1, f_1, h_1, h_2, h_3$), 3 pairs of anal setae (ps_1, ps_2, ps_3) and 2 pairs of cupules (*im, ip*) in dorsal position. All dorsal setae setiform. Lengths of dorsal setae: v_1 27–35, v_2 25–32, sc_1 21–26, sc_2 23–34, c_1 18–23, c_2 22–28, d_1 16–20, e_1 18–22, f_1 22–29, h_1 22–23, h_2 30–32, h_3 24–29; anal shields with 3 pairs of setae (ps_{1-3}), anal setae dorsally ps_1 26–34, ps_2 28–33, ps_3 28–30. Distances between dorsal setae: v_1-v_1 24–26, v_2-v_2 112–121, sc_1-sc_1 47–54, sc_2-sc_2 157–166, c_1-c_1 22–24, c_2-c_2 133–142, d_1-d_1 80–105, e_1-e_1 85–113, f_1-f_1 51–73, h_1-h_1 41–65, h_2-h_2 92–137, h_3-h_3 131–168, v_1-sc_1 44–59, v_2-sc_2 32–36, c_1-c_2 63–75, c_1-d_1 41–60, d_1-e_1 32–45, e_1-f_1 33–43, f_1-h_1 22–40, h_1-h_2 40–52, h_2-h_3 32–43.

Venter (Fig. 10). Ventral idiosoma striated; coxae III–IV surrounded by punctate endopodal shield. Length of setae *Ia* 40–49, *Ib* 35–41, *Ic* 33–37, *2b* 30–36, *2c* 28–34, *3a* 31–44, *3b* 22–27, *3c* 28–35, *4a* 34–40, *4c* 33–37, *ag₁* 32–42, *ag₂* 30–34, *ps₁* 23 (24–28). Aggenital area with 2 pairs of setae (*ag₁₋₂*); 1 pair of cupules (*ih*) located in ventral idiosoma posterolateral and in position.

Gnathosoma (Figs. 12–13). Ventral infracapitulum with 2 pairs of subcapitular setae, *m* 43–51 and *n* 40–52, 2 pairs of adoral setae, *or₁* 22–27, *or₂* 24–28 (Fig. 13). Palp 5-segmented, palp tarsus with 4 simple setae + 1 solenidion (ω) + 4 sub terminal spine-like eupathidia, tibia with 3 simple setae + 1 small claw, palp genu with 2 setae and palp femur with 3 setae (Fig. 12). Chelicera 87–88, movable digits 77–86 (Fig. 9).

Legs (Figs. 14–17). **Setal formulae of leg segments** as follows: coxae 2–2–2–1; trochanters

1–1–2–1; femora 6–5–3–2, genua 6 (1κ)–6 (1κ)–4–4; tibiae 6 (1φρ)–6 (1φρ)–6 (1φρ)–5 (1φρ); tarsi 22 (1ω)–21 (1ω)–16 (1ω)–15 (1ω). Tarsi I–IV with a solenidion. Length of solenidia as follows: Iω 24–26, IIω 22–25, IIIω 24–26, IVω 22–25; Iφρ 8–12, IIφρ 9–11, IIIφρ 23–25, IVφρ 24–25; Iκ 4–7, IIκ 5–6.

Remarks. *Raphignathus hatamii* sp. nov. resembles *R. africanus* Meyer et Ueckermann, 1989, in having the interscutal membrane with two setae, dorsal setae are simple, the palpfemur is with 3 setae. However, the new species differs from *R. africanus* by the tarsal setation I–IV 22 (1ω)–21 (1ω)–15–14 instead 21 (2ω)–16 (1ω)–13–12 in *R. africanus*, the cupules (*im*) are located on interscutal membrane medially whereas near anterior margin of opisthosomal shield in *R. africanus*.

Immature stages. Unknown

Etymology. This species is named in honor of Mr. Mohammad Hatami, who helps us in the mites' collection.

Key to the Iranian species of *Raphignathus* (females)

1. Interscutal membrane dorsomedially with 2 (d_1, e_1) or 3 (d_1, e_1, f_1) pairs of setae 2
— Interscutal membrane dorsomedially with 1 (d_1) pair of setae 9
2. Interscutal membrane dorsomedially with 2 pairs of setae (d_1, e_1) 3
— Interscutal membrane dorsomedially with 3 pairs of setae (d_1, e_1, f_1) *R. larestaniensis* Bagheri, Akrami et Majid
3. Femur IV with 2 setae 4
— Femur IV with 3 setae 5
4. Tarsi I with 2 solenidia *R. africanus* Meyer et Ueckermann
— Tarsi I with 1 solenidion *R. hatamii* sp. nov.
5. Endopodal shields present 6
— Endopodal shields absent 8
6. Small shields present posterolateral to median prodorsal shields *R. hecmataniensis* Khanjani et Ueckermann
— Small shields absent posterolateral to median prodorsal shields 7
7. Median propodosomal shield widely separated from peritremes anteriorly; setae e_1 short and not reaching anterior margin of opisthosomal shield *R. giselae* Meyer et Ueckermann

- Median propodosomal shield adjacent to peritremes anteriorly; setae e_1 long and reach to anterior margin of opisthosomal shield *R. gracilis* (Rack)
8. Genital shields with 4 pairs of setae *R. saboorii* Ghorbani et al.
- Genital shields with 3 pairs of setae *R. aciculatus* Fan et Yin
9. Femur II with 6 setae *R. protaspus* Khanjani et Ueckermann
- Femur II with 5 setae 9
10. All dorsal setae short and setiform *R. collegiatus* Atyeo, Baker et Womersley
- All dorsal setae long and thick 10
11. Femur IV with 2 setae *R. zhaoi* Hu, Jin et Liang
- Femur IV with 2 setae *R. ensipilosus* Meyer et Ueckermann

ACKNOWLEDGEMENTS

This paper is a part of an MSc thesis program in Entomology and was supported by the University of Razi, Kermanshah, Iran. The authors would like to thank vice research of Razi University for financial support of this project.

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