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Article

Redescription of *Favognathus insularis* (Luxton) (Acari: Trombidiformes: Cryptognathidae) from Brazil, with a key to the world species of *Favognathus*

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ABSTRACT

Until now, *Favognathus insularis* (Luxton, 1973) has been only known from the Niue Island. In recent surveys conducted in the Brazilian state of São Paulo, a second record of this species was provided. It is redescribed here based on the adult females. Also, an identification key to known species of *Favognathus* is provided.

KEY WORDS: New record; Prostigmata; Raphignathoidea; predatory mites; soil.

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INTRODUCTION

Members of the family Cryptognathidae Oudemans have been suggested as predators (Meyer and Ryke 1960), and they have been considered as microphytophages (Swift and Goff 2001). Cryptognathid mites are associated with edaphic habitats, especially moss, leaf litter and leaf mold, but are also known from bark and lichens (Doğan 2008). They can be easily recognized by their prodorsal hood, large prosternal plate (apron) and highly extrusible gnathosoma.

Cryptognathidae comprises 64 species in three genera: *Favognathus* Luxton (42 species), *Cryptognathus* Kramer (21 species) and *Cryptofavognathus* Doğan & Dönel, 2010 (2 species) (Fan and Zhang 2005; Doğan 2008; Khanjani and Ueckermann 2008; Dönel and Doğan 2011; Hassanzadeh *et al.* 2014; Khanjani *et al.* 2014; Shirinbeik Mohajer *et al.* 2014; Mohammad Doustaresharaf *et al.* 2019).

Until now, known species of the family Cryptognathidae have never been recorded from Brazil, except an unpublished species reported in a thesis, by Flechtmann in 1971 as “*Cryptognathus agapictus*”; it was collected from hollow of a tree (no mention the name of tree).

During taxonomic study of raphignathoid mites from Brazil, a new record of *Favognathus* was identified. Herein, the main goal of the paper is to redescribe and reillustrate *Favognathus insularis* (Luxton, 1973) which is a new record for the Brazilian mite fauna and to provide a global identification key.

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MATERIAL AND METHODS

Samples of soil and rotten leaves were taken from ESALQ–USP, Piracicaba, Brazil. Mites were extracted by using a Berlese-Tullgren funnel and preserved in AGA solution (Smiley 1992). Specimens were cleared in lactophenol solution, mounted in Hoyer's medium (Walter and Krantz 2009), and were examined under a phase-contrast microscope (Olympus BX 41). Initial illustrations were made using a drawing tube attached to the phase-contrast microscope, scanned, and cleaned up using Adobe Illustrator CS6. The length of the gnathosoma was measured from the base to the tip of the subcapitulum, the length of the idiosoma from the suture between the gnathosoma and idiosoma to the posterior margin of the idiosoma, the width of the idiosoma at its broadest level, and the legs from the ventral insertion of coxae to the base of the pretarsi. The terminology and abbreviations are based on Grandjean (1944) and Kethley (1990). All measurements are given in micrometers (μm).

RESULTS

Family Cryptognathidae

Genus *Favognathus* Luxton, 1973

Type species: *Cryptognathus cucurbita* Berlese, 1916, by original designation.

Cryptognathus (Favognathus) Luxton, 1973: 62.

Type species: *Cryptognathus cucurbita* Berlese, 1916, raised to genus by Luxton (1987).

Favognathus insularis (Luxton, 1973) (Figs. 1–9)

Cryptognathus insularis - Luxton, 1973: 64.

Favognathus insularis (Luxton) - Luxton, 1987: 113; Krisper and Schneider 1998: 201; Doğan, 2008: 1677.

Diagnosis

Anterior margin of the hood smooth; dorsal and ventral shield laterally ornamented with reticulations; reticular cells with 4–6 peripheral pores and short striae; dorsoventrally with four slit-like cupules; dorsum with one pair of cluster associated with setae d_1 ; intercoxal area smooth; femora I–IV: 4–3–2–2; genua I–IV: 5(+ κ)–4(+ κ)–2–3 tarsi I–IV: 15(+ ω_1 + ω_2)–12(+ ω_1 + ω_2)–9(+ ω)–9(+ ω).

Distribution

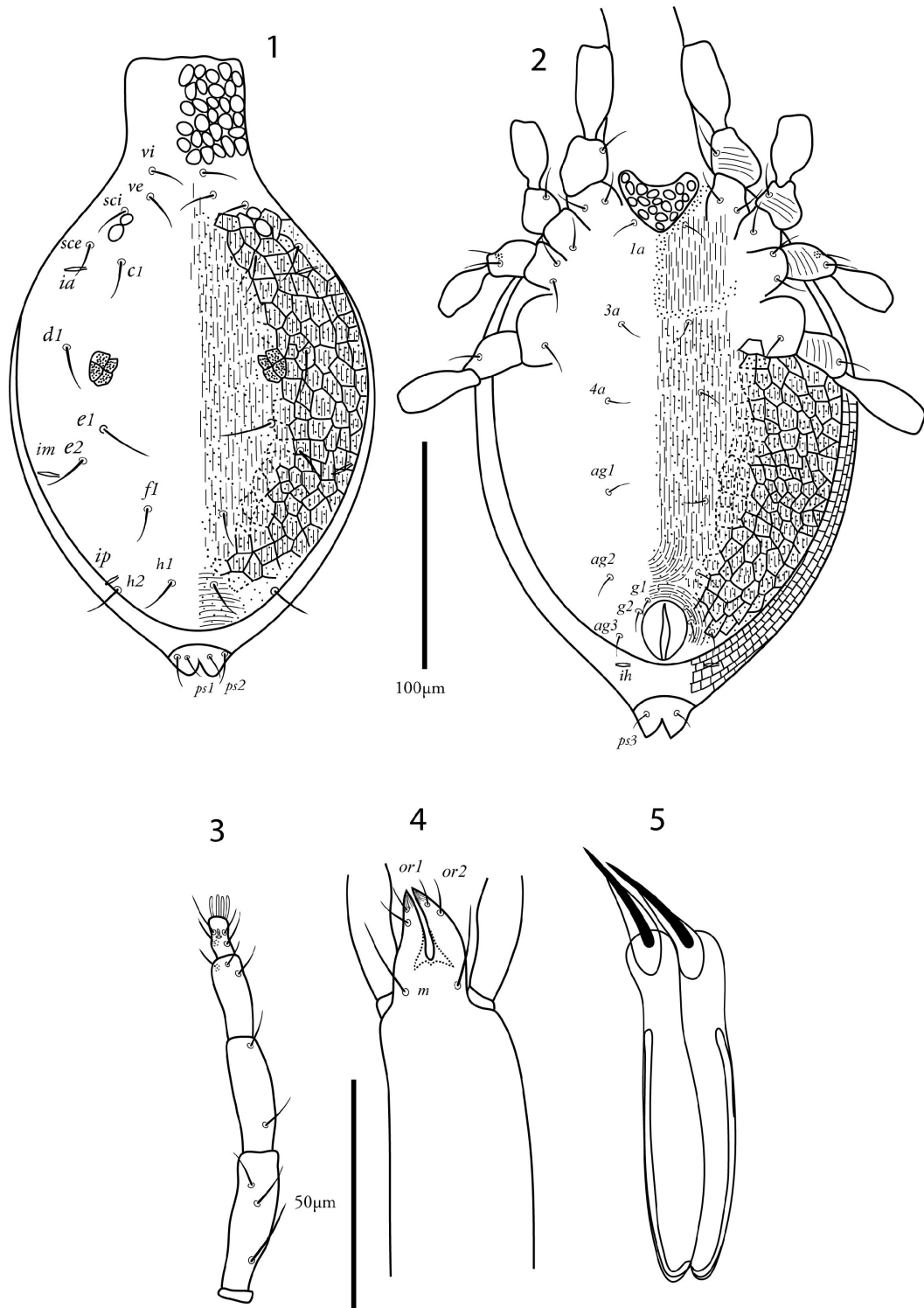
Niue Island (Luxton 1973); Brazil (in this study).

Description

Female (n = 4) – Red-colored while alive. Length of body 260–283; Length of subcapitulum 87–97; width of body: 144–180; leg I: 198–221, leg II: 161–179, leg III: 142–165, leg IV: 180–191.

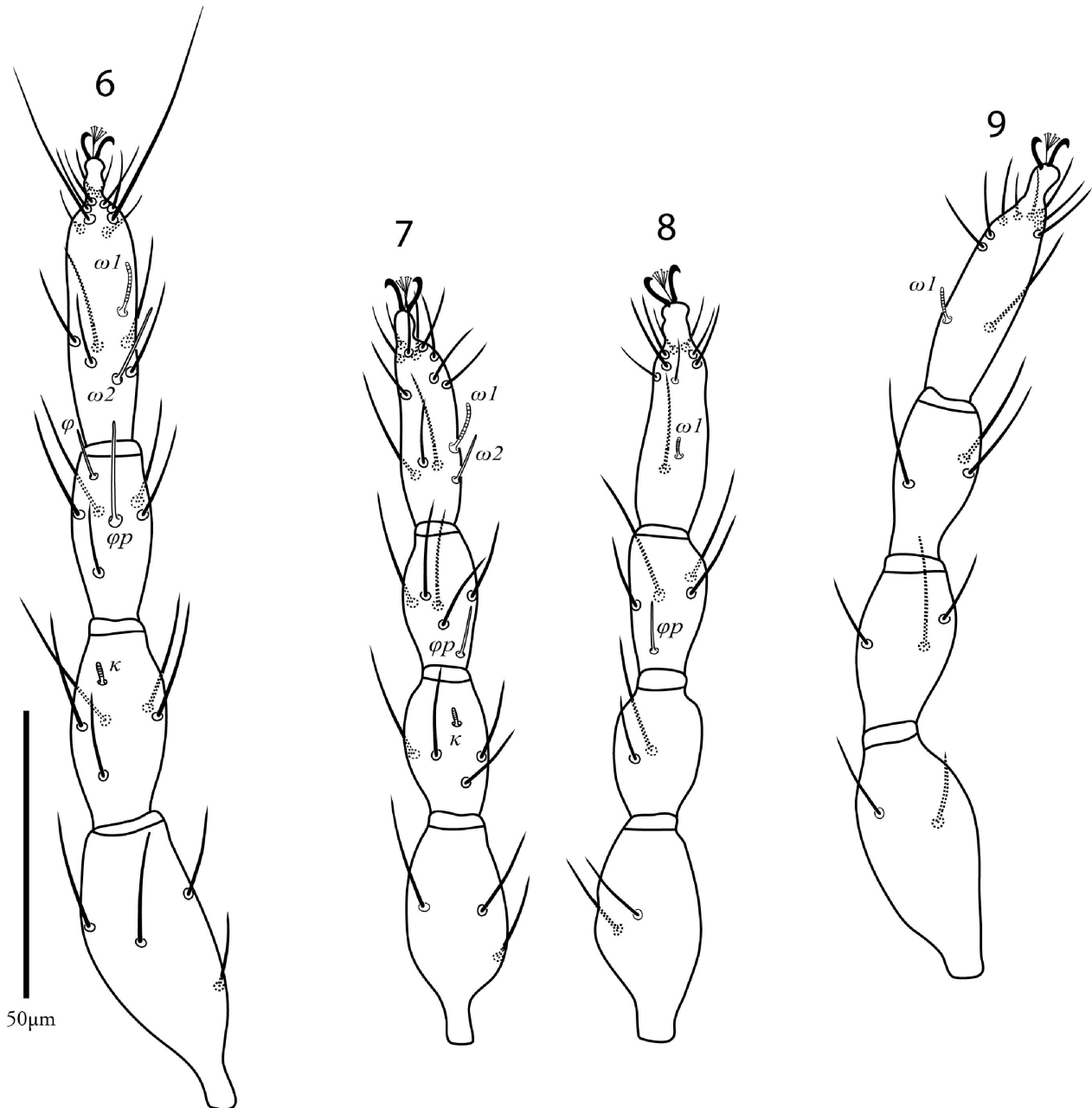
Dorsum (Fig. 1) – Anterior margin of the hood smooth; hood with 6–7 dimples in each longitudinal row. Dorsal shield ornamented with pores, evenly distributed, lateral parts of dorsal shield reticulated; central area of dorsum with punctuations and striations (Fig. 1, B); reticulate pattern formed by cells, each bearing 4–6 pores periphery and pores distributed evenly in all reticulation cells; short striae; dorsum with 11 pairs of simple setae, one pair of eyes and one pair of postocular bodies laterally between setae sci and sce ; dorsal body with three pairs of slit-like cupules as follows: ia between setae sce and c_1 , im beside setae e_2 and ip beside setae h_2 ; a cluster of reticulated cells associated with setae d_1 present, these rosette patterns consist of four cells; anal opening dorsoventrally, with three pairs of setae (ps_{1-3}). Length of dorsal setae and their distances: vi 13–14;

ve 21–25; sci 17–19; c1: 25–28; sce: 22–25; d1: 26–30; e1: 26–29; e2: 22–27; f1: 25–28; h1: 23–26; h2: 18–20; vi–vi: 32–38; vi–ve: 8–10; ve–ve: 32–37; sci–sci: 49–53; sci–sce: 21–32; c1–c1: 56–60; sce – sce 84–100; c1–d1 45–49; d1–d1: 100–110; d1–e1: 34–42; e1–e1: 68–72; e2–e2: 93–96; e1–f1: 41–42; f1–f1: 33–38; f1–h1: 28–32; f1–h2: 36–40; h1–h1: 14–19; h1–h2 21–29; h2–h2: 68–72.



Figures 1–5. *Favognathus insularis* (Luxton, 1973) (female) – 1. Dorsal view of idiosoma; 2. Ventral view of idiosoma; 3. Palp; 4. Subcapitulum; 5. Chelicera.

Venter (Fig. 2) – Prosternal apron wedge-shaped with 15–18 foveolae; venter with three pairs of ventral setae (*1a*, *3a* and *4a*); genital opening with two pairs of genital (*g*₁₋₂) and three pairs of aggenital (*ag*₁₋₃) setae; ventral shield with lateral reticulations, fine striae and pores, intercoxal area smooth and with a longitudinal row of pores; venter with cupule *ih*. Length of ventral setae: *1a* 11–12, *3a* 12–13, *4a* 11–13, *ag*₁ 9–10, *ag*₂ 9–10, *ag*₃ 8–9, *g*₁ 10–11, *g*₂ 10–11; *ps*₁ 11–13, *ps*₂ 10–11, *ps*₃ 8–10.



Figures 6–9. *Favognathus insularis* (Luxton, 1973) (female) – 6. Leg I; 7. Leg II; 8. Leg III; 9. Leg IV.

Gnathosoma (Figs. 3–5) – Hypostome narrow (Fig. 4), with one pair of long setae *m* 22–27 and two pairs of adoral setae, *or*₁ 4–5, *or*₂ 7–8 (Fig. 4); chelicerae 84–90; (Fig. 5); palp (Fig. 3) 80–91 long, palptarsus with four eupathidia, four simple setae and one solenidion; palptibia with three simple setae; palpgenu with two and palpfemur with three simple setae. Palp trochanter without setae.

Legs (Figs. 6–9) – Setal formulae of leg segments (solenidia in parentheses and not included): coxae 2–1–2–1; trochanters 1–1–2–1; femora 4–3–2–2; genua 5(+ κ)–4(+ κ)–2–3; tibiae 5(+ ϕ + ϕp)–5(+ ϕp)–4(+ ϕp)–3; tarsi 15(+ ω 1+ ω 2)–12(+ ω 1+ ω 2)–9(+ ω 1)–9(+ ω 1).

Male and immature stages – Unknown.

Material examined

Four females from soil and rotten leaves, collected on September 28, 2015 at Piracicaba, state of São Paulo, Brazil by Saeid Paktinat-Saeij. All specimens are deposited in the Acarological Collection, Department of Plant Protection, Faculty of Agriculture, University of Maragheh, Maragheh, Iran.

Remarks

The original description of this species is incomplete and insufficiently illustrated. The Brazilian specimens show all characters of the original description but with more details. Herein, we provide the only description of this species containing complete details with legs setal number which is missed in previous ones. The morphological characteristics and general appearance of the Brazilian specimens are similar to those of the original description of Luxton (1973). However, it differs from newly found specimens in length and width of dorsal shield and length of some dorsal setae of which are longer than those of the original description, for example: length of dorsal setae d_1 26–30, e_1 26–29, f_1 25–28 in Brazilian specimens versus d_1 22, e_1 26, f_1 22 in original description. Furthermore prosternal apron with 15–18 foveolae versus 14 foveolae in specimens collected by Luxton (1973).

Flechtmann (1971) mentioned the family Cryptognathidae in his unpublished thesis and described a new species as *Cryptognathus agapictus* Flechtmann, 1971 (*Favognathus agapictus* (Flechtmann, 1971)), since it is not published, according to ICZN - Article 8, *C. agapictus* is an invalid species. Based on similarity of the characters and descriptions of these specimens, it seems that they are conspecific.

Key to the females of known species of *Favognathus*

1. Dorsum with rosette patterns..... 2
 - Dorsum without rosette patterns 17
2. Dorsum with one rosette patterns..... 3
 - Dorsum with two rosette patterns 4
3. Cluster of cells associated with setae c_1 , trochanter III with one setae
 - *F. distinctus* Swift
 - Cluster of cells associated with setae d_1 , trochanter III with two setae
 - *F. insularis* (Luxton)
4. Dorsum evenly punctuated *F. erzrumensis* Doğan & Ayyildiz
 - Dorsum partly or completely reticulated..... 5
5. Dorsum partly reticulated..... 6
 - Dorsum completely reticulated 9
6. Genu I with 5 setae; femur I with 5 setae..... *F. maritimus* (Shiba)
 - Genu I with 5(+1 κ) setae; femur I with 4 setae..... 7
7. Tarsi III–IV with 8(+1 ω) setae; femur II with 2 setae *F. turcicus* Koç & Ayyildiz
 - Tarsi III–IV with 9(+1 ω) setae; femur II with 3 setae 8
8. Setal formula of tarsi 16-14-10-10 *F. amygdalus* Doğan & Ayyildiz
 - Setal formula of tarsi 17-14-10-10 *F. pongolensis* Meyer & Ueckermann
9. Anterior margin of hood denticulated 10
 - Anterior margin of hood smooth 13
10. Genu II with 4 setae; femur I with 3 setae *F. observabilis* (Kuznetsov)
 - Genu II with 4(+1 κ) setae; femur I with 4 setae 11

11. Intercoxal area smooth *F. esfahaniensis* Khanjani *et al.*
 – Intercoxal area striated 12
12. All reticulation cells of dorsal shield with pores and short striae; rosette patterns consist of 6–8 cells *F. hyrcanensis* Shirinbeik Mohajer & Bagheri
 – Medial reticulation cells of dorsal shield with pores; rosette patterns consist of 2–5 cells
 *F. guilanicus* Khanjani *et al.*
13. Genu II without famulus κ 14
 – Genu II with famulus κ 15
14. Intercoxal area with nonporous areas rest of venter covered with evenly distributed pores; prosternal apron with 16 foveolae..... *F. texasensis* (McDaniel & Bolen)
 – Intercoxal area finely striated with few punctations, reticulations posterior to coxae IV; prosternal apron with 12 foveolae *F. luxtoni* Koç & Ayyildiz
15. Setal formula of tarsi 16-14-12-8..... *F. pictus* (Summers & Chaudhri)
 – Setal formula of tarsi not as above..... 16
16. Setal formula of tarsi 16-12-10-10..... *F. bafranus* Doğan
 – Setal formula of tarsi 17-14-10-10..... *F. distortus* (Kuznetsov)
17. Dorsum evenly punctuated 18
 – Dorsum partly or completely reticulated 27
18. Anterior margin of hood wavelike..... *F. dakotaensis* (Mc Daniel & Bolen)
 – Anterior margin of hood denticulated or smooth..... 19
19. Anterior margin of hood denticulated..... 20
 – Anterior margin of hood smooth..... 23
20. Ventral shield partly reticulated..... *F. izmirensis* Akyol
 – Ventral shield punctuated or striated 21
21. Prosternal apron with 10 dimples *F. denticulatus* (Luxton)
 – Prosternal apron with more than 10 dimples 22
22. Prosternal apron with 16–18 dimples *F. ochraceus* (Summers & Chaudhri)
 – Prosternal apron with 25 dimples *F. magnus* (Luxton)
23. Femur I with 3 setae..... *F. leopardus* (Luxton)
 – Femur I with 4 setae..... 24
24. Tarsi I with 13(+2 ω) setae *F. kamili* Donel & Doğan
 – Tarsi I with 15(+2 ω) setae 25
25. Tarsi II with 11(+2 ω) setae *F. kazemii* Mohammad Doustaresharaf & Bagheri
 – Tarsi II with 12(+2 ω) setae 26
26. Prosternal apron with 14–18 dimples *F. orbiculatus* (Livshitz)
 – Prosternal apron with 17–19 dimples *F. cypselus* Fan
27. Dorsum completely reticulated 28
 – Dorsum partly reticulated 30
28. Addorsal setae *tc* on tarsus II dissimilar *F. rugosus* (Livshitz)
 – Addorsal setae *tc* on tarsus II similar 29
29. Anterior margin of hood denticulated; dorsal shield with faint reticulations and striate.....
 *F. favus* (Summers & Chaudhri)
 – Anterior margin of hood smooth; dorsal shield with strong reticulations and striate.....
 *F. gersoni* Luxton
30. Anterior margin of hood denticulated..... 31
 – Anterior margin of hood smooth..... 34
31. Genu II with 4(+1 κ) setae *F. alvandii* Khanjani *et al.*
 – Genu II with 5(+1 κ) setae 32
32. Setal formula of tarsi 16-13-10-10..... *F. goffi* Swift
 – Setal formula of tarsi not as above..... 33

33. Setal formula of tarsi 15-14-10-9.....*F. dama* (Chaudhri, Akbar & Rasool)
 – Setal formula of tarsi 17-14-10-10..... *F. farshchiani* Jafari *et al.*
34. Hood wider than long *F. barrasi* (Smiley & Moser)
 – Hood longer than wide..... 35
35. Trochanter IV without setae*F. variabilis* Swif
 – Trochanter IV with one setae..... 36
36. Genu II without famulus κ 37
 – Genu II with famulus κ 38
37. Tarsi II with 11(+2 ω) setae*F. latibarrus* Meyer & Ueckermann
 – Tarsi II with 12(+2 ω) setae.....*F. cucurbitellus* (Meyer & Ryke)
38. Femur I with 3 setae..... *F. cucurbita* Berlese
 – Femur I with 4 setae..... 39
39. Sternocoxal area with a pair of angular condyles *F. cordylus* Luxton
 – Sternocoxal area without angular condyles 40
40. Setal formula of tarsi 17-14-10-10.....*F. mirazii* Khanjani & Ueckermann
 – Setal formula of tarsi not as above..... 41
41. Genu IV with 2 setae; prosternal apron with 20 dimples.....
*F. naghii* Hassanzadeh *et al.*
 – Genu IV with 3 setae; prosternal apron with 14 dimples.....
 *F. acaciae* Doğan & Ayyildiz

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بازتوصیف گونه *Favognathus insularis* (Luxton) (Acari: Trombidiformes: Cryptognathidae) از برزیل به همراه کلید گونه‌های جهان جنس *Favognathus*

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چکیده

تاکنون گونه *Favognathus insularis* (Luxton, 1973) تنها از جزیره نیو (Niue Island) شناخته شده بود. در بررسی‌های اخیر انجام شده در ایالت سائوپائولو برزیل، دومین گزارش از این گونه در جهان ارایه می‌شود. این گونه، براساس ماده‌های بالغ بازتوصیف شده است. کلید شناسایی گونه‌های شناخته شده جنس *Favognathus* نیز تهیه شده است.

واژگان کلیدی: پیش‌استیگمایان؛ بالانواده *Raphignathoidea*؛ گزارش جدید؛ کنه‌های شکارگر؛ خاک.

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